



A Report Prepared for:

Shell Oil Products US
2555 13th Avenue SW
Seattle, Washington 98134

OPERATION AND MAINTENANCE MANUAL

NPDES PERMIT NO. WA-000179-1

SHELL SEATTLE DISTRIBUTION TERMINAL

APRIL 1, 2013

828.001.01.004

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1.0 INTRODUCTION

1.1 Purpose

This operation and maintenance manual has been prepared to document the procedures that will be implemented by Equilon Enterprises LLC, dba Shell Oil Products US (Shell), at the Shell Seattle Distribution Terminal for compliance with its NPDES Permit No. WA-000179-1. The current permit was issued February 16, 2010, and it expires February 15, 2015. This manual supplements other facility operations and maintenance manuals and is intended to focus on sources that may impact the facility's oil/water separator operations.

1.2 Manual Organization

The manual has been organized into the following sections: facility description, containment drainage procedures, oil/water separator, carbon system, special operations, and sampling and monitoring.

1.3 Emergency Notification

1.3.1 Facility Supervisor Notification

If the main oil/water separator, carbon treatment system, or zinc treatment system is malfunctioning, immediately notify one of the following personnel:

<u>Name</u>	<u>Office Number</u>	<u>Cell Number</u>
Shaun Wilkinson	206/224-0484	(b) (6)
Tom Eikmeier	916/371-6911	(b) (6)
Theresa Geijer	206/618-9061	(b) (6)

If the system continues to malfunction after you have tried to troubleshoot, one of the following must be called:

1. PES Environmental Office
(8am to 5pm, Monday through Friday) (206) 529-3980
2. PES Field Cell Phones
 - a. Erin Shaver: (b) (6)
 - b. Jason Landskron: (b) (6)
 - c. Leora Doody: (b) (6)
 - d. Russ Stolsen: (b) (6)
 - e. Bill Haldeman: (b) (6)

1.3.2 Washington State Department of Ecology Notification

Consistent with Section S3.E of Shell's NPDES permit, Shell will notify the Washington State Department of Ecology (Ecology) if any of the following circumstances occur:

1. Any noncompliance that may endanger health or the environment.
2. Any bypass that leads to an exceedance of a permit effluent limitation. The permit defines a bypass as an "intentional diversion of waste streams from any portion of a treatment facility". As described in Section S4.B of the permit, Ecology may authorize a bypass under certain conditions, such as essential maintenance, construction, and under conditions that could lead to loss of life, injury, or severe property damage.
3. Any upset that leads to an exceedance of a permit effluent limitation. The permit defines an upset as "an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee". As described in Section G15 of the permit, Ecology may not seek enforcement against an upset if the cause of the upset can be identified and the facility treatment systems were operating properly during the upset.
4. Any violation of a maximum daily or instantaneous maximum discharge limitation for any of the parameters monitored under the permit.
5. Any overflow upstream of the treatment components of the system (the carbon treatment system, the stormwater [zinc] treatment system, and the oil/water separators), whether or not the overflow endangers health or the environment or exceeds any permit effluent limitation.

After first taking actions to stop, contain, and cleanup an unauthorized discharge or correct a noncompliance, Shell will implement the following permit-required notification procedures:

1. **24-Hour Reporting.** Shell will notify the Ecology permit manager, Jeanne Tran, by telephone of the noncompliance within 24 hours of Shell's learning of the noncompliance. Jeanne Tran's telephone number is (425) 649-7078.
2. **5-Day Report.** Shell will follow the 24-hour report with a written report within 5 days of Shell's learning of the noncompliance. The report will contain:
 - a. A description of the noncompliance and its cause.
 - b. The period of the noncompliance, including dates and times where known.
 - c. The estimated time the noncompliance is expected to continue if it has not been corrected.
 - d. Steps taken or planned to reduce, eliminate, or prevent recurrence of the noncompliance.
 - e. If the noncompliance involves an overflow upstream of the treatment components, an estimate of the untreated overflow volume.

3. **30-Day Data Submittal.** Consistent with the permit, Shell will transmit any analytical results from follow-up sampling done to verify the initial sampling results to Ecology within 30 days of sampling

1.4 Treatment System Operating Plan

Consistent with Section S4.A of Shell's NPDES permit, this section presents a summary of the operating conditions under a variety of discharge conditions, including baseline, low-flow, upset, and maintenance-related discharges.

1.4.1 Baseline Operating Conditions

Under baseline (normal) operating conditions, Shell's stormwater collection, conveyance, and treatment systems are designed to operate in an unattended fashion. Stormwater flows through a majority of the systems by gravity, with automated pumping systems conveying water through specific pre-treatment systems (the carbon treatment system for contact water and the stormwater treatment system used to remove zinc prior to discharge). The automated pumping systems are controlled by a series of floats and sensors, and have alarms to alert terminal personnel if the systems are not functioning properly. To ensure that all of the systems are operating properly and that the effluent limits are met at Outfalls 001 and 002, a prescribed set of inspections, maintenance, and monitoring are conducted. These tasks are discussed in Section 3.0.

1.4.2 Low Flow Operating Conditions

During extended periods of dry weather, the volume of water flowing through the stormwater collection, conveyance, and treatment systems decreases considerably. Instead of more frequent periods of continual flow and treatment, the systems operate in less frequent batches. The collection, conveyance, and treatment systems function the same during periods of infrequent rain, they just operate less frequently. Shell continues to conduct inspections, maintenance, and monitoring to ensure proper system operations, so there is no decrease in system treatment efficiency during periods of low flow.

1.4.3 System Upsets

Sections 3.2.3 and 4.2 describe the procedures to be used in the case of upsets due to facility activities (spills or maintenance-related releases) at the main oil/water separator and light oils truck loading rack, respectively. For a spill or release entering the stormwater collection and conveyance system, the valve downstream of the main oil/water would be shut to allow capture of the spill in the separator, and the collected product would be pumped into rental tanks or trucks and handled appropriately; the stormwater system would not be returned to service until it was cleaned. For major spills at the truck loading rack, the product would be collected in the underground separator/spill containment tank or aboveground equalization tank, and the collected product would be pumped into rental tanks or trucks and handled appropriately. The strip drains, piping, and tanks that contacted product would be cleaned prior to return to service.

Excessive stormwater flow generated by severe storm events would first overflow water onto the ground surface to the south and west of the light oils office (Drawing 1), where the water would be stored until it flowed into the main oil/water separator. If enough excess stormwater was generated, the excess water would overflow a weir in the main oil/water separator, which would allow discharge through the outfall bypassing the stormwater treatment system (zinc treatment system). Shell would obtain temporary tanks if possible, with bypass of the stormwater treatment system a last resort. If bypass of any system were to occur in a severe storm event, Shell would document the water quality of the discharged water.

1.4.4 Maintenance-Related Discharges

Maintenance-related activities that source water to the stormwater conveyance and treatment systems include rinsing of the truck loading rack pavement with potable water, hydrotesting the dock pipeline, and drawing water off of the bottom of 13 tanks in the main tank farm. All of this water is collected in an underground oil/water separator-spill containment tank (tank UG-4), pumped through particulate filters, and then treated in carbon canisters before being added to the stormwater conveyance system. Inspections, maintenance, and monitoring of these treatment systems are conducted to ensure that the maintenance water is pre-treated properly before being added to stormwater.

2.0 FACILITY DESCRIPTION

The Shell Seattle Distribution Terminal was constructed in 1947 and comprises 20.5 acres of land on the north central part of Harbor Island (Figure 1). The facility is divided into three parcels: the main terminal and tank farm (2555 13th Avenue SW), the north tank farm (1835 13th Avenue SW), and the shoreline manifold area and dock (1711 13th Avenue SW). The facility receives, stores, and distributes bulk fuel oils, including gasoline, diesel, biodiesel, aviation gasoline, and jet fuel.

2.1 Main Terminal and Tank Farm

The main terminal and tank farm are located on 17.5 acres lying west of 13th Avenue SW, south of SW Florida Street, east of 16th Avenue SW, and north of SW Lander Street. The terminal layout and infrastructure discussed below are shown on Drawing 1.

2.1.1 Petroleum Receipt, Storage, and Distribution

The main terminal and tank farm contain the following operational structures:

- Three office buildings;
- A light oil truck loading rack (constructed in 1981) located on a concrete pad south of the garage, with a canopy, dedicated product-loading arms, and underground pipelines delivering fuel to the rack;
- A truck pumpoff pad (constructed in 2008) located immediately west of the southern lane (Lane 6) of the light oil loading rack;
- Pipeline receipt facilities;
- A rail receipt facility located west of the main tank farm;
- One regulated underground storage tank (UST);
- Four unregulated underground tanks (process tanks);
- Two small aboveground storage tanks (red dye tanks);
- 20 aboveground product storage tanks;
- A pumphouse and manifold pit located south of the main tank farm;
- A vapor recovery system;
- Piping and pumps;
- Drum storage areas;
- Two laboratories;
- Maintenance operations; and
- A garage (no current garage activity).

The main terminal receives primarily light oils (fuels) via the Olympic Pipe Line from Northwest Washington refineries, ethanol and aviation gasoline via rail, and neat biodiesel and ethanol via truck. Lube operations, including storage and distribution, ceased in December 2003, and the lubricants infrastructure (including all lubricant tanks in the southern part of the terminal, the lubricants railcar unloading area, the southern truck loading rack, associated piping systems, the western manifold pit, the two warehouses, the blending building, the boiler, and the boiler UST) were removed in late 2012.

2.1.2 Wastewater Management and Treatment Systems

The main terminal and tank farm contain a variety of structures to manage and treat wastewater under the Shell NPDES permit. Figure 2 presents a process flow diagram of the wastewater sources and treatment systems. Process wastewater and stormwater infrastructure includes drip pans, strip drains, catch basins, water conveyance piping, oil/water separators, spill containment tanks, a carbon treatment system, a zinc treatment system, and two discharge outfalls (Outfall 001 in the southeast corner of the terminal and Outfall 002 on the western main terminal boundary). The primary wastewater sources are stormwater runoff from paved surfaces and roof drains, with lesser amounts of truck loading rack washwater and occasional discharges of hydrotest water and tank contact water. All stormwater is treated by one of the oil/water separators at the facility prior to discharge at Outfall 001 or Outfall 002. All process water (including stormwater runoff and washwater from the truck loading rack, dock pipeline hydrotest water, and tank contact water) is treated by carbon vessels prior to flowing into the main oil/water separator. All water flowing through the main oil/water separator is treated by a zinc treatment system prior to discharge at Outfall 001. A brief description of the stormwater treatment employed at the terminal follows:

Oil/Water Separators. Three oil/water separators are located at the main terminal (Drawing 1):

1. The main oil/water separator is in the southeast corner of the main terminal; it drains to the city storm drain line at the intersection of SW Lander Street and 13th Avenue SW (Outfall 001). The main oil/water separator was constructed in 1947 and modified in October 2005. Currently, most stormwater drainage in the main terminal (including catchment areas A, B, C, and D, as shown on Drawing 1) drains to the main oil/water separator. Process water from the truck loading rack, the truck pumpoff pad, and UST 3300 (also known as UST UG-3A), which collects tank contact water (see Drawing 1), ultimately flows through the main oil water separator.
2. A 10,000-gallon underground oil/water separator tank (UG-4) is connected downstream of the light oil truck-loading rack. The tank separates any minor drips of oil from the loading rack and provides for containment in case of a spill at the loading rack. The tank discharges to the carbon treatment system.
3. A smaller oil/water separator, constructed in 1991, is located south of the employee building on the western boundary of the main terminal. It collects stormwater runoff from the driveways in the southwest portion of the main terminal (catchment area E shown on Drawing 1). The smaller oil/water separator drains to the city storm drain line on the West side of 16th Avenue SW (Outfall 002).

Carbon Treatment System. A carbon treatment system is used to treat stormwater and wash water from the light oil loading rack, the truck pumpoff pad, and UST 3300 in the main terminal, and dock pipeline hydrotest water. The light oil loading rack is equipped with a canopy, concrete pad, concrete curbs, and strip drains. The strip drains lead to a 10,000-gallon underground oil/water separator tank (UG-4), four particulate filtration canisters, four 2,000-pound carbon treatment vessels, and ultimately the main oil/water separator. The truck pumpoff pad is constructed with a canopy, a concrete pad, a strip drain, and underground piping that leads to the 10,000-gallon underground oil/water separator tank (UG-4) and an underground sump used to contain a product spill. An automated valve and pipe overflow to the underground sump are used to isolate the pumpoff pad from the stormwater conveyance systems during truck pumpoff.

Stormwater (Zinc) Treatment System. A zinc treatment system was integrated with the main oil/water separator in 2005 to treat stormwater so that discharge through Outfall 001 meets the permit limit for zinc. Water in the oil/water separator is pumped to the zinc treatment system, which consists of two treatment vaults with filter media that are located immediately west of the oil/water separator; after the water flows by gravity through the vaults, it returns to the final chamber of the main oil/water separator for discharge through Outfall 001.

2.2 North Tank Farm

The north tank farm comprises 2.5 acres immediately northwest of the intersection of 13th Avenue SW and SW Florida Street. The tank farm contains two aboveground storage tanks, both about 1,500,000 gallons in size, which are currently out of service. No wastewater is generated from this portion of the facility.

2.3 Shoreline Manifold Area

The shoreline manifold area and dock lie on 0.5 acres of land on the north side of the intersection of 13th Avenue SW and SW Massachusetts Street. Elliott Bay is adjacent to the north edge of the shoreline manifold area. The area contains manifolds controlling the flow of product between the tank farms and the dock. Stormwater runoff is not generated at the shoreline manifold area due to the unpaved surface. The dock lies 250 feet to the west of the shoreline manifold area and extends 590 feet into Elliott Bay. Stormwater from the dock is managed by Rainier Petroleum, the tenant of ExxonMobil.

3.0 OPERATIONS AND MAINTENANCE

This section summarizes the operation and maintenance (O&M) procedures for the systems managing and treating wastewater discharged under Shell's NPDES permit.

3.1 Aboveground Tank Secondary Containment

3.1.1 Containment Description

The main tank farm has secondary containment to prevent the release of petroleum products in the event of a spill. The drainage system in the main tank farm (see valve 2 on Drawing 1) is normally kept closed and locked, which can cause the accumulation of water over time. If necessary, the accumulated water is drained as described below.

3.1.2 Containment Drainage and Inspection Procedures

Prior to draining the water that has accumulated in the main tank farm, the following procedures are to be completed:

1. Drainage from this area must be authorized and supervised by the terminal manager.
2. Inspect the surface of the water contained in the containment area. If there is no petroleum product and/or sheen present, then slowly open the valve and allow the discharge of water from the containment area.
3. Log the drainage on the Dike Drain Report form (Form ES-1 in Appendix A).
4. If petroleum product and/or sheen are present, notify the terminal manager.
5. Quarterly, the valve function and condition of this drainage system will be inspected (Table 1), with the results recorded on Form ES-2 (see Appendix A).

3.2 Oil/Water Separators

This section discusses the main oil/water separator and small oil/water separator located in the main terminal. The underground separator/spill containment tank (UG-4) is discussed with the carbon treatment system in Section 3.3.

3.2.1 System Description

The main oil/water separator is located in the southeast corner of the facility (see Drawing 1). Stormwater from most of the main terminal (drainage basins A through D, Drawing 1) is conveyed to the oil/water separator by a system of catch basins and underground gravity drains. Constructed in 1947, the separator was designed to remove floating petroleum material from stormwater prior to being discharged to the municipal storm sewer. The 69-foot long by

17.3-foot wide by 11 feet deep separator was modified in October 2005 and is currently divided into three compartments as shown on Figure 3.

The northern 12.5 feet of the main oil/water separator comprises the first compartment for water entering the separator. This compartment serves as the oil/water separation compartment, with two concrete and two metal separation baffles; the first three baffles are successively deeper, serving to remove floating oil and sinking sediment from the water as it flows through the compartment. Water must flow over the last baffle through a V-notch weir to exit this compartment.

The second compartment of the main oil/water separator is 51 feet long and comprises the storage compartment, providing sufficient volume to, when combined with the storm drain volume and limited surface water ponding (south of the light oils office), store the runoff from a 10-year, 24-hour storm. Water is pumped from this compartment into the stormwater treatment system (zinc treatment system, see Section 3.5); if the volume of water generated from a storm were to exceed the 10-year, 24-hour storm volume, water would overflow the southern wall of this compartment (whose height is 1 foot below the top of the oil/water separator) into the third compartment. There is an underflow baffle immediately before the southern wall of this compartment to protect the third compartment.

The third compartment of the main oil/water separator is 5.5 feet long and comprises the discharge compartment of the oil/water separator. Water from the stormwater treatment system enters this compartment through the north wall and exits the western part of the compartment through a concrete pipe in the southern wall. Two filter cages previously located at the downstream end of the compartment (the first contained excelsior [wood fibers] for final polishing of the water before discharge and the second contained calcium carbonate gravel to provide pH control of the water) have been removed, as their functions have been replaced by the stormwater treatment system.

The small oil/water separator is located on the north side of the former warehouse addition. Constructed in 1991, the underground concrete separator was designed to remove floating petroleum material from stormwater collected from the paved area north and northeast of the former warehouse (drainage basin E, Drawing 1). The small oil/water separator is approximately 11 feet long, 5.5 feet wide, and 9 feet deep, with two metal baffles to remove floating oil and a bottom-entry discharge pipe (the clearwell) in the third compartment for water discharge to Outfall 002. Oil-absorbent pads are placed on the water surface near the clearwell to provide additional protection for the water to be discharged through the clearwell.

3.2.2 Operation and Maintenance

The following operation and maintenance procedures for the main oil/water separator (Outfall 001) and the small oil/water separator (Outfall 002) will be implemented at the terminal to meet conditions specified in NPDES Permit No. WA-000179-1. Table 1 summarizes the periodic inspections, monitoring, and maintenance that will be conducted. The terminal manager will maintain and retain records of inspection, maintenance, and disposal.

1. The oil/water separators operate 24 hours per day. Runoff from the enclosed tank farm and product transfer area will be directed to the main oil/water separator for separation and filtration before discharge to Outfall 001. Runoff from the paved area north and northeast of the former warehouse will be directed to the small oil/water separator for treatment before discharge to Outfall 002.
2. The main and small oil/water separator systems will be visually inspected **DAILY** to ensure that no visible sheen is present in the discharge. The visual inspection is accomplished by looking in the last compartment of the main separator and through the clearwell in the last compartment of the small separator. If sheen is noted, absorbent pads, booms, or both will be changed out (see No. 4 below), the terminal manager will be notified immediately, and the source of the sheen will be investigated. Results of the inspections will be entered on an NPDES Monitoring Daily Log Form (Form ES-3) and Shell's Daily Terminal Inspection Form. Form ES-3 and Shell's Daily Terminal Inspection Form are provided in Appendix A.
3. A pH reading will be taken **DAILY** in the main separator by using pH paper or a pH meter. Readings will be taken in the western portion of the last compartment near the discharge pipe (Outfall 001). A pH reading will be taken **MONTHLY** in the small separator clearwell (Outfall 002) using either pH paper or a pH meter. If a pH meter is used, the meter will be calibrated, cleaned, and operated accordingly to the manufacturer's instructions (see Appendix B). Results will be entered on the NPDES Monitoring Daily Log Form (Form ES-3). The permit-allowed pH range at Outfall 001 is between 6.5 and 8.5. If a pH is measured outside the range of 6.5 to 8.5, the following procedure will be followed:
 - A. Collect a fresh sample from the oil/water separator and repeat the measurement. If the pH reading is in the acceptable range, no additional investigation will be performed. The second reading will be the one recorded on the NPDES Monitoring Daily Log Form.
 - B. If the pH measurement is still outside the acceptable range, replace the batteries, clean and recalibrate the probe, and repeat the measurement with a fresh sample. If the pH reading is in the acceptable range, no additional investigation will be performed. The reading generated after probe cleaning and calibration will be the one recorded on the NPDES Monitoring Daily Log Form.
 - C. If after battery replacement, probe cleaning, and probe recalibration the separator pH reading is still outside of the acceptable range, the results will be reported to the terminal manager for reporting to Ecology, and the source will be investigated.
4. Absorbent pads and/or a boom will be placed in the third compartment of the main oil/water separator and the third chamber of the small oil/water separator to ensure effective system performance. The absorbent pads and/or booms will be visually inspected **DAILY** (Table 1). If sheen is observed and the pads, boom, or both appear

saturated, they will be replaced and the surface of the oil/water separator skimmed, if needed.

5. The amount of rain recorded by the rain gauge will be documented on Form ES-3 at approximately the same time daily. The rain gauge will be inspected as needed (Table 1) to confirm that no debris has blown into the bucket and that the tipping mechanism moves freely. The rain gauge will be cleaned and calibrated according to the manufacturer's instructions (see Appendix B).
6. Oil/water separator sludge will be removed when the accumulation impacts system operation efficiency, or about every five years for the main oil/water separator and every two to three years in the small oil/water separator, whichever is shorter. The sludge will be disposed of consistent with state and federal regulations for waste disposal.
7. After the sludge is removed, the separators and clearwell will be cleaned and visually inspected to ensure that the integrity of the system has been maintained. If repairs to the system are needed, they will be made before the system is put back into service. Alternative storage of water (e.g., a Baker tank) will be used while the system is out of operation.
8. Catch Basin and Drainage Pipe Inspections (Table 1):
 - Catch Basins – representative catch basins will be inspected approximately annually to determine the amount of sediment buildup. If the catch basins are at least 60 percent full or if sediment is within 6 inches of the lowest pipe invert, sediment will be removed. The sediment will be profiled and disposed of consistent with state and federal disposal regulations.
 - Drainage Piping – drainage pipes in representative catch basins will be inspected approximately annually to determine the amount of sediment buildup. If the drainage pipes are at least $\frac{1}{3}$ full, sediment will be removed. The sediment will be profiled and disposed of consistent with state and federal disposal regulations.
9. Table 2 provides a record of major inspections and maintenance.

3.2.3 Oil/Water Separator Emergency Procedures

The main oil/water separator is designed to passively remove floating oil and zinc (particulate and dissolved) from stormwater collected at the facility. The small oil/water separator is designed to passively remove floating oil from the stormwater collected at the facility. Both separators are operated as “flow-through” systems as opposed to “batch” processes. Any oil accumulation that is observed in the small oil/water separator during routine inspections will be pumped into a drum or tank immediately.

The main oil/water separator discharge valve is normally open allowing treated stormwater to be discharged on demand. In the event of an emergency spill or release that could migrate to the separator, procedures will be undertaken to prevent the discharge of the spill. The following

procedures will be implemented in response to a spill (or if test results indicate that water in the main separator exceeds NPDES discharge monitoring standards):

1. Notify the terminal manager immediately.
2. Close the oil/water separator discharge valve.
3. Order portable tanks from either:

Baker Tanks

9715 24th Place West
Everett, Washington 98204
(425) 347-0369 or (800) 225-3712

or

Rain for Rent

19430 59th Avenue NE
Arlington, WA 98223
(360) 403-3091 or (800) 742-7246

4. Notify your Environmental Coordinator.
5. Pump from all oil/water separator compartments with product and any affected catch basins and stormwater pipes to the portable tank(s).
6. Analyze water and product, and handle as appropriate.
7. Clean all compartments with product, all impacted catch basins, and all impacted stormwater pipes; and
8. Fill the oil/water separator above the bottom of the oil/water separating baffles as necessary, and open the oil/water separator discharge valve.

3.3 Underground Storage Tank 3300

3.3.1 Description

UST 3300 collects tank contact water (tank bottom draw water) and small amounts of product from the light-oil truck-loading rack funnels, the product testing laboratory, railcar aviation gasoline sampling, and potentially dock pipeline hydrotesting. The 10,000 gallon UST is located south of the east manifold pit (see Drawing 1). Tank 3300 is equipped with a hydrocarbon sensor, float switches, and a pump to direct water off of the bottom of the tank to an adjacent existing catch basin (catch basin B21 shown on Drawing 1).

3.3.2 Containment Drainage Procedures

Product levels in UST 3300 will be monitored daily. When sufficient product builds up in the tank, it will be skimmed and shipped off site for recycling. Depending on the amount of product and water in the UST at the time of product recycling, water may also be pumped and shipped off site for treatment and disposal. If the UST fills primarily with water, the water may be pumped off of the bottom of the UST into catch basin B21, where it will gravity flow to the

underground separator/spill containment tank (Tank UG-4) for treatment by the carbon treatment system (as discussed below). No product or water will be pumped out of the UST without the approval and oversight of the terminal manager.

3.4 Spill Containment Tank and Carbon System

This section documents the light oil rack underground separator maintenance procedures, carbon system description, carbon system monitoring requirements, troubleshooting procedures, and maintenance requirements for the carbon treatment system at the Shell Seattle Distribution Terminal. The operator will follow these procedures during daily operations and if an emergency occurs. Table 1 summarizes the periodic inspections, monitoring, and maintenance that will be conducted.

3.4.1 System Description

The Shell carbon treatment system was installed in January 1995 to treat water with gasoline compounds from the light oil load rack underground separator/spill containment tank (UG-4) prior to discharge to the main oil/water separator. The capacity of the carbon treatment system was doubled in a 2012 expansion. The system currently consists of the following: an underground separator/spill containment tank (UG-4), a collection sump, two sump pumps (Numbers 301 and 302), a 10,000-gallon aboveground flow equalization tank (AG-W1), two transfer pumps (Numbers 303 and 304), four particulate filtration canisters, four carbon filtration canisters, an electrical supply and control system, a heat trace control system, and associated piping (Figure 4).

Water primarily enters the underground separator/spill containment tank from three sources (Figure 2): (1) contact water manually pumped from UST 3300, (2) contact water from the truck pumpoff pad (Lane 6), and (3) stormwater runoff and contact water collected from the fuel loading area strip drains. The separator discharges water only into the collection sump, which contains two sump pumps and four float switches. Water from the collection sump is pumped into the equalization tank. The transfer pumps direct water from the equalization tank through the particulate filtration canisters and then through the carbon filtration canisters. After the water is carbon treated, it discharges into catch basin B3, which is part of the catchment area B storm drain system (Drawing 1) that drains to the main oil/water separator. The system normally operates automatically by using water level sensors. It can, however, also be operated manually during system maintenance events.

Aboveground piping and equipment is heat traced and insulated to keep it from freezing. A dedicated heat trace control system automatically activates the heat trace when ambient temperatures fall below 45°F.

3.4.2 Spill Containment Tank Inspection and Maintenance

The underground separator/spill containment tank (UG-4) is located on the south side of the light oil fuel loading rack. The tank acts as an oil/water separator for small amounts of light fuels that may be released during the filling of trucks.

Tank UG-4 inspections will be done on a weekly basis and recorded on the NPDES Monitoring Daily Log Form (Form ES-3). The strip drains will be inspected daily to limit the chance of biofuels reaching the carbon treatment system. All inspections will be documented on Form ES-3 (Appendix A).

3.4.3 Carbon System Operations

System Monitoring. System monitoring includes checking the system control panel, alarm indicators, and carbon canister operating pressure. Figure 4 includes a detailed schematic drawing of the system control panel.

Check the **system control panel** daily for the following conditions and document the inspection on Form ES-3 (Appendix A):

1. The **main power safety switch** should be in the “on” position.
2. The **sump pump and transfer pump switches** should be in the “auto” position (the indicator lights will be on only if the pumps happen to be operating during the inspection).
3. The **alarm light** should not be on.

A more detailed inspection of the system will be performed monthly and recorded on the Carbon Treatment System Inspection Log (Form ES-4). Form ES-4 is provided in Appendix A. Check the control panel, sump pumps, equalization tank, and carbon canisters as outlined on the form. Check the influent and intermediate carbon canister pressure gauges (pressure gauges P5, P6, P11, and P12 shown on Figure 4). The pressure indicator should read less than 12 pounds per square inch (psi) when pumping. The pressure can be adjusted by opening or closing the control valve on the inlet line before the carbon filtration canisters.

Troubleshooting. Under normal operation, the sumps and transfer pumps operate in the automatic mode. The “pump on” indicators are controlled by level sensors which cycle the pumps on and off. The flow rate through each series of the carbon canisters should be between 20 and 30 gallons per minute (gpm). The maximum allowable inlet pressure for the carbon filtration canisters is 12 psi.

When the carbon treatment system is in an alarm state, an alarm indicator light will activate on the system control panel, an audible horn will activate, and a visual revolving strobe light will activate. Pushing the “Alarm Acknowledge” button on the control panel will silence the audible horn, however, the indicator light on the control panel and overhead strobe light will remain active for as long as the cause of the alarm condition is in effect. The system will continue to operate as normal while in an alarm state and no machinery will be automatically disabled.

There are two possible conditions which cause a system alarm: (1) the high level float switch has been activated in the equalization tank (AG-W1) or (2) the high level float switch has been activated in the collection sump. To determine the cause of a system alarm:

1. Check the level gauge on top of the equalization tank AG-W1.
 - a. If the level gauge shows that the tank is full and/or water is observed returning to the strip drain from the bypass line, refer to the equalization tank troubleshooting table below. Any electrical work must be done by a qualified electrician.
 - b. If the level gauge shows that the tank is less than half full, refer to the collection sump troubleshooting table below.

Equalization Tank Troubleshooting.

Possible Problem	Operation Check	Action
The transfer pump could be malfunctioning (Pump #303 & #304).	<ol style="list-style-type: none"> 1. Use manual mode to check for pump operation. 2. Check fuses if pump will not operate in manual mode. Check sensors if pump works in manual but not in automatic mode. 	If pump cannot be restarted, call terminal supervisor or manager and an electrician.
Transfer pump water inlet may be blocked.	If possible, use a long pole (gauge stick) to determine if an object(s) is blocking the equalization tank effluent port.	If object is blocking the equalization tank effluent port, try to dislodge the object with the pole. If the pump cannot be reactivated, call the terminal supervisor or manager.
The particulate filter influent flow rate is reduced, preventing adequate transfer flow rate from the equalization tank to the carbon units.	Check the influent flow rate by verifying that the pressure difference across the particulate filters (P2,P3-P4 and P8,P9-P10) is less than 15 psi (typical operation is less than 5 psi).	If pressure difference is elevated (15 psi or greater), change the filter cartridges and return to service. Check for inlet blockage.
The carbon vessel flow rate is reduced, preventing adequate transfer flow rate from the equalization tank to the carbon units.	<ol style="list-style-type: none"> 1. Check primary carbon influent pressure from both series by verifying that the pressure is less than 12 psi (P5, P11). 2. Check flow rate through the carbon canisters by verifying that the flow rate is between 20-30 gpm from each series. 3. Check automatic bleed valves on top of the carbon canisters to ensure proper operation. 	<ol style="list-style-type: none"> 1. Adjust carbon influent valve such that P5, P11 < 12 psi and flow rate is between 20-30 gpm. 2. If flow rate is too low when P5, P11 < 12 psi, then arrange to back flush the primary carbon unit. 3. Replace fouled or inoperable automatic bleed valves, as needed.

Collection Sump Troubleshooting.

Possible Problem	Operation Check	Action
One of the two (or both) sump pumps could be clogged or malfunctioning and unable to keep up with influent water.	Turn sump pump switches (Sump Pump #301 & #302) to manual mode to check pump operation.	If pump(s) is not operating call the terminal supervisor or manager and electrician immediately.
The inflow from the underground separator spill tank could be more than the pump discharge capacity.	Turn the sump pump switches to manual to check the pump operation and check pump discharge into equalization tank for restrictions of the full flow capability.	If pump is not operating, call the terminal supervisor or manager and electrician immediately. If flow is restricted, check for blockages in collection sump. Remove if possible.
The system control panel and/or sensors could have a malfunction: <ul style="list-style-type: none"> – electrical problem – tripped circuit breaker – float switch problem 	Check circuit breaker if pump will not operate in manual mode. Check sensors/float switches in collection sump if pump works in manual, but not in automatic mode.	If automatic mode does not work, allow pumps to pump in manual mode. Caution: the pumps cannot be left running when the collection sump is empty. Notify terminal supervisor or manager immediately to arrange repairs.

In the event of system bypass from the collection sump, the terminal manager and environmental personnel will be notified, and water samples will be collected from the carbon treatment system and outfalls, as appropriate, to document water quality conditions at the time of bypass.

Maintenance. If benzene is detected above the discharge limit at the intermediate location during performance sampling (see below), the terminal manager will be notified immediately to arrange for a carbon changeout.

Each leg of the carbon treatment system includes two particulate filters that have been installed just upstream of the primary carbon unit. The particulate filters are Rosedale Model 8 cartridge filters each containing six 30-inch wound cartridges (nominal 10-micron). The purpose of these filters is to remove particulate material that would otherwise prematurely plug the carbon units. The particulate filters must be maintained by replacing the filter cartridges when the pressure across the filter exceeds 15 psi. Replacement cartridge filters for this unit are usually a stock item, so it is not advisable to operate the treatment system without cartridge filters in place.

To determine the particulate filter back-pressure, activate the **transfer pump** and read the difference in the pressures across the filter vessels from pressure gauges located on the top side of each filter housing to the pressure gauges located on the effluent side of the filtration units. If the gauge differential reads greater than 15 psi, shut the system down and replace the filter cartridges. A specification sheet with cartridge ordering instructions is provided in Appendix D. To replace the cartridges:

1. Shut the system down by deactivating the **main power safety switch** at the **system control panel**.

2. Check the inlet pressure gauge on the particulate filter to ensure the pressure is zero (0 psi). If it is not 0 psi, then slowly open the pressure bleed valve on the top of the filter housing, if installed. If the bleed valve is an automatic bleed valve style and the pressure is not 0 psi, then replace the bleed valve.
3. Open the filter housing and remove and replace the filter cartridges per the manufacturer's (Rosedale) instructions included in Appendix B.
4. Close and reseal the filter housing and start system to confirm leak-free operation.
5. Turn on transfer pump, fill filters with water, and bleed off any air trapped in the filter housing.
6. Note operating pressure readings after filter replacement.

Performance Sampling. Discharge from the first carbon canister to the second from each series will be sampled periodically to assess and maintain good filtration. Sampling will be performed as follows:

1. Influent, effluent, and mid-system water samples will be collected from each series of the carbon treatment system every 6 months.
2. If sufficient rainfall has not already initiated pumping through the system, the pumps will be turned on manually and be allowed to run for a few minutes before sampling.
3. The water samples will be submitted to a laboratory for analysis of BTEX by United States Environmental Protection Agency (USEPA) Method 8260.

3.4.4 Winter Conditions Operations

Current cold-weather system protection includes insulation and heat tape on all influent pipelines and carbon canisters. Additional precaution and inspections should be implemented, as necessary, during winter conditions with extensive subfreezing temperature. The system and associated pipelines should be inspected daily for integrity during periods of subfreezing temperatures.

3.5 Stormwater Treatment System

This section documents the stormwater treatment system description, monitoring requirements, troubleshooting procedures, and maintenance requirements. The operator will follow these procedures during routine operations and if an emergency occurs. Table 1 summarizes the periodic inspections, monitoring, and maintenance that will be conducted. Appendix E provides the manufacturer's maintenance guidelines.

3.5.1 System Description

The Shell stormwater treatment system (zinc treatment system) consists of the following (Figures 3 and 5): two 130-gallons per minutes (gpm), 1.5-horsepower lift pumps (that cycle on an alternating basis); two aboveground, precast, Stormwater Management (now Contech Stormwater Solutions) StormFilter[®] vaults each filled with 35 filter cartridges containing Metal Rx[™] filtration media; transfer piping between the oil/water separator and stormwater treatment vaults; and an electrical supply and control system (Figure 6). Appendix E provides descriptions of the stormwater treatment system control panel and float switches, and the StormFilter[®] manufacturer's reference material.

The stormwater treatment system operates by pumping stormwater from the second compartment of the oil/water separator through subsurface and aboveground PVC pipes to the primary treatment vault located approximately 25 feet west of the oil/water separator on the east side of the eastern warehouse (Drawing 1). Stormwater then gravity drains through the primary treatment vault, through piping to the secondary treatment vault, through the secondary treatment vault, and then into the third compartment of the oil/water separator.

During routine operations, the lift pumps operate automatically using water level sensors and cycle on an alternating basis. There are two level sensor trees (LSLH-101 and LSH-104). LSH-104 is the oil/water separator high level alarm light and horn switch indicating stormwater treatment system bypass. LSLH-101 consists of four float switches as follows:

1. LSL-101: low level pump shut-off switch;
2. LSH-101: high level pump on switch;
3. LSHH-101: high-high level back-up pump on switch that also activates the high level alarm light and horn; and
4. LSLH-101: low-low level alarm light and horn switch.

The pumps are also controlled by two sets of float switches, FSH-102 and FSL-103. FSH-102 turns on the back-up pump if the flow rate through the V-notch weir is high enough. FSL-103 is a switch that activates the pump low-flow warning alarm light and horn.

If the water level is high enough in the second compartment of the oil/water separator or the rate of water level rise is high enough, both pumps are operated. The lift pumps can also be operated manually. The filter cartridges in the vaults contain fine, granular, organic filter media made from deciduous leaves and work passively by trapping particulates and adsorbing metals.

3.5.2 System Inspection and Maintenance

Three types of maintenance will be performed on the stormwater treatment system: minor maintenance, major maintenance, and event-based maintenance.

1. Minor maintenance will be performed on a quarterly basis and will involve inspection of the two StormFilter[®] vaults; removal of vegetation, trash, or other debris, if necessary; and flow testing of the lift pumps.
2. Major maintenance will be scheduled and performed based on the results of the minor maintenance events; major maintenance will involve replacement of the cartridge media and removal of sediment from the vaults.
3. Event-based maintenance will be conducted after major storm events or petroleum spills that reach the main oil/water separator; this type of maintenance will involve inspection of the vaults, removal of any collected debris, and water quality sampling (if a petroleum spill has occurred).

Following are maintenance procedures based on the manufacturer's guidelines.

Minor Maintenance Procedures. Following are procedures for minor maintenance events, including system inspection, minor vault cleaning, and system water sampling. These procedures may be modified based on experience gained during system maintenance.

1. Use the appropriate safety equipment for work performed in and around the vaults.
2. Observe the external condition of each vault and record the observations on an inspection form (see Appendix E). Include observations of any terminal activities that may have an impact on the stormwater treatment system.
3. Observe and note on the inspection form the condition of the inside of each vault, including the condition of the individual components of the vault; the amount of and location of any vegetation, trash, or other debris; the level of sediment on the floor of the vault and on top of the cartridges; the level of water in the vault; and the approximate flow rate of water through the vault.
4. Remove any vegetation, trash, or debris if possible from each vault using a pole with a hook or net on the end. Dispose of the material appropriately.
5. Observe the stormwater treatment system control panel. The alarm lights (low level, high level, pump fail, pump seal leak, float switch, bypass condition, and overflow) should be off. The main power safety switch should be in the "on" position, and both of the pump control switches should be in the "auto" position. Record the observations on the inspection form (Appendix E).
6. Observe the lift pumps, if possible. Note the condition of the pumps, and remove any accumulated debris around the pumps with a pole with a hook or net on the end.

Major Maintenance Procedures. Following are procedures for major maintenance events, including replacement of the filter cartridge media and removal of accumulated sediment in the vaults. These procedures may be modified based on experience gained during system maintenance.

1. Use the appropriate safety equipment for work performed in and around the vaults.

2. Observe the external condition of each vault and record the observations on an inspection form (see Appendix E). Include observations of any terminal activities that may have an impact on the stormwater treatment system.
3. Observe and note on the inspection form the condition of the inside of each vault, including the condition of the individual components of the vault; the amount of and location of any vegetation, trash, or other debris; the level of sediment on the floor of the vault and on top of the cartridges; the level of water in the vault; and the approximate flow rate of water through the vault.
4. Remove any vegetation, trash, or debris if possible from each vault using a pole with a hook or net on the end. Dispose of the material appropriately.
5. Enter the vault, and remove the filter cartridges to be replaced from the vault using the manufacturer's procedures (see Appendix E).
6. Remove deposited sediment on the floor of the vault with a shovel or vacuum truck.
7. Observe the condition of the inside of the vault and condition of the manifold and connectors (2-inch-diameter PVC pipes protruding from the floor of the vault). If necessary, replace any damaged connectors and apply a light coating of silicon grease to the outside of the connectors (for a watertight fit).
8. Using a boom, crane, or tripod, lower and install the new filter cartridges.
9. Observe the stormwater treatment system control panel. The alarm lights (low level, high level, pump fail, pump seal leak, float switch, bypass condition, and overflow) should be off. The main power safety switch should be in the "on" position, and both of the pump control switches should be in the "auto" position. Record the observations on the inspection form (Appendix E).
10. Observe the lift pumps, if possible. Note the condition of the pumps and remove any accumulated debris around the pumps with a pole with a hook or net on the end.
11. Appropriately store, sample, and dispose of residual sediment and filter media.
12. Contact Contech Stormwater Solutions at 1-800-548-4667 to return the used filter cartridges.

Event-Based Maintenance Procedures. Following are procedures for event-based maintenance events, to be implemented after a major storm event or petroleum spill that reaches the main oil/water separator.

1. Use the appropriate safety equipment for work performed in and around the vaults.
2. Observe the external condition of each vault and record the observations on an inspection form (see Appendix E). Include observations of any terminal activities that may have an impact on the stormwater treatment system.
3. Observe and note on the inspection form the condition of the inside of each vault, including the condition of the individual components of the vault; the amount of and location of any vegetation, trash, or other debris; the level of sediment on the floor of the vault and on top of the cartridges; the level of water in the vault; and the approximate flow rate of water through the vault.

4. Remove any vegetation, trash, or debris if possible from each vault using a pole with a hook or net on the end. Dispose of the material appropriately.
5. Observe the stormwater treatment system control panel. The alarm lights (low level, high level, pump fail, pump seal leak, float switch, bypass condition, and overflow) should be off. The main power safety switch should be in the “on” position, and both of the pump control switches should be in the “auto” position. Record the observations on the inspection form (Appendix E).
6. Observe the lift pumps, if possible. Note the condition of the pumps and remove any accumulated debris around the pumps with a pole with a hook or net on the end.
7. Based on the size of the spill, the distribution of the product in the main oil/water separator, and the timing of the lift pump shutdown, influent, mid-point, and effluent water samples may need to be collected to evaluate the condition of the vaults. If so, collect performance water samples as described below. Submit the samples with the proper chain-of-custody form to an analytical laboratory for analysis of zinc using USEPA Method 200.7 and petroleum hydrocarbons (see Table 3).

3.5.3 Performance Sampling

Water samples will be collected from the system monthly (when there is flow through the treatment system) to document system performance and provide data to help determine the need to change the filter media. The following sampling schedule and procedures will be followed:

1. Water samples will be collected during a storm significant enough to initiate flow through the second treatment vault. If flow through the second vault has stopped, but there is sufficient water in the second compartment of the oil/water separator, the pumps may be manually started to resume flow through the system for sampling purposes.
2. Water samples will be collected from the first filter vault inlet, the second filter vault inlet (mid-point sample), and the discharge to the last compartment of the oil/water separator in laboratory-provided metals sampling bottles.
3. The samples will be submitted with the proper chain-of-custody form to an analytical laboratory for analysis of zinc using USEPA Method 200.8.

3.5.4 Troubleshooting

Under normal operation, the lift pumps operate in the automatic mode. The “pump on” indicators are controlled by level sensors that cycle the pumps on and off. The flow rate from each lift pump should be approximately 130 gpm.

High level alarm condition (indicator light is lit and the horn is sounding) means that either high-high level switch LSHH-101 has been tripped, activating the back-up pump, or high level switch LSH-104 has been tripped, indicating that water is bypassing the stormwater treatment system and flowing directly into the third compartment of the oil/water separator. There are four reasons this light could be on:

Possible Problem	Operation Check	Action
One of the two (or both) lift pumps could be malfunctioning.	Turn each lift pump switch to the manual mode to check pump operation.	If pump(s) is not operating call the terminal supervisor or manager and electrician immediately.
The system control panel and/or sensors could have a malfunction: <ul style="list-style-type: none"> – electrical problem – tripped circuit breaker – float switch problem – flow switch problem 	Check circuit breaker if pumps will not operate in manual mode. Check sensors/float switches in oil/water separator if pumps work in manual mode but not in automatic mode. Check that flow switch FSH-102 turns on the back-up pump.	If automatic mode does not work, allow pumps to pump in manual mode. The pumps cannot be left running when the oil/water separator is empty. Notify terminal supervisor or manager immediately to arrange repairs.
The flow rate through the stormwater treatment system could be reduced due to a blockage.	Turn each lift pump switch to manual to check pump operation and check pump discharge into the primary treatment vault to confirm full flow capability. If possible, use a long pole (gauge stick) to determine if an object(s) is blocking the pump intakes.	If flow is restricted, check for blockages at lift pumps and in treatment vaults. Remove if possible.
The inflow to the main oil/water separator could be more than the designed capacity of the stormwater treatment system (260 gpm).	Check the flow rate from the oil/water separator compartment through the weir, if possible. Turn each lift pump switch to manual to check pump operation and check pump discharge into the primary treatment vault to confirm full flow capability.	If the stormwater treatment system is fully operational but not keeping up with inflow to the oil/water separator, call the terminal supervisor or manager to document the extreme rainfall event. Document approximate bypass volume. Bypass overflows must be documented and reported to Ecology.

Low-low level alarm condition shows that the lift pumps are continuing to pump when not needed. There is one reason this light could be on:

Possible Problem	Operation Check	Action
The system control panel and/or sensors could have a malfunction: <ul style="list-style-type: none"> – electrical problem – float switch problem 	Check sensors/float switches in oil/water separator if pumps work in manual mode but not in automatic mode.	If automatic mode does not work, turn off the pumps to allow the water level in the second compartment of the oil/water separator to rise. Manually monitor the water level and start the pumps, as necessary. Notify terminal supervisor or manager immediately to arrange repairs.

Pump fault alarm condition shows that the lift pumps are not operating properly. There are three reasons this light could be on:

Possible Problem	Operation Check	Action
One of the two (or both) lift pumps could be malfunctioning.	Turn each lift pump switch to the manual mode to check pump operation.	If pump(s) is not operating properly call the terminal supervisor or manager and electrician immediately.
The flow rate through the stormwater treatment system could be reduced due to a blockage.	Turn each lift pump switch to manual to check pump operation and check pump discharge into the primary treatment vault to confirm full flow capability. If possible, use a long pole (gauge stick) to determine if an object(s) is blocking the pump intakes.	If flow is restricted, check for blockages at lift pumps and in treatment vaults. Remove if possible.
The system control panel and/or sensors could have a malfunction: <ul style="list-style-type: none"> – electrical problem – tripped circuit breaker – flow switch problem 	Check circuit breaker if pumps will not operate in manual mode. Check low flow switch (FSL-103) to see if operating properly.	If automatic mode does not work, allow pumps to pump in manual mode. The pumps cannot be left running when the oil/water separator is empty. Notify terminal supervisor or manager immediately to arrange repairs.

In the event of system bypass, the terminal manager and environmental personnel will be notified, and water samples will be collected from Outfall 001 to document water quality conditions at the time of bypass.

3.5.5 Winter Conditions Operations

The pipes in the stormwater treatment system are protected from freezing since most are underground and those that are aboveground should not be full of water during periods of subfreezing temperatures. According to the manufacturer, the filter cartridges drain between storm events and should not be full of water during periods of subfreezing temperatures. To confirm that no aboveground pipes have cracked, additional inspections (minor maintenance) should be implemented, as necessary, during winter conditions with extensive subfreezing temperatures. The necessity of these inspections will be re-evaluated based on the data collected from inspections performed during winter conditions with extensive subfreezing temperatures.

4.0 SPECIAL OPERATIONS

Special operations (e.g., firefighting system tests, tank hydrotest) occur at the Terminal on a varied basis. To ensure compliance with Shell's NPDES permit, the following procedures have been established for these operations.

4.1 Truck Rack Firefighting System

The light fuels truck rack and the truck pumpoff pad are both equipped with automatic firefighting foam sprinkler systems. In the event of a fire, the foam systems are activated spreading foam over the entire area of the rack and pad. At regular intervals (water flow is tested annually) and when ordered by the fire department, the foam system must be tested by activating the system for approximately 15 minutes. Diverters have been installed to eliminate the need to dump foam during tests. The diverters allow a small amount of foam to be diverted to a sample container, thus eliminating the generation of foam during tests.

The following procedures will be performed in conjunction with firefighting system tests if foam were to be used in a flow test:

4.1.1 Foam Application Test

1. In advance of the test, provisions will be made to have two vacuum tankers (or a portable 20,000 gallon tank) on site (approximately 10,000-gallon tankage capacity) capable of pumping a minimum of 250 gpm each. One truck will be staged near the southwest drain discharge and the other near the southeast drain discharge.
2. The truck rack strip drains will be plugged where they discharge to the underground separator/spill tank. It is critical that no foam be allowed to enter the underground separator/spill tank.
3. The vacuum truck operators will position their suction hoses inside the strip drains at the southeast and southwest corners. Vacuum will be applied to the drains when the foam test begins. Note: foam may be generated inside the vacuum tankers - the vacuum discharge port should be positioned so that ejected foam will stay within the truck rack drainage area.
4. After completion of the foam test, the residual foam will be washed into the strip drains and collected in the vacuum tankers. When the area has been cleaned, the strip drain discharge plugs will be removed.

4.1.2 Annual Water Flow Test

Flow plugs are to be placed in each discharge drain pipe leading from the rack to the underground oil/water separator tank. Flows should not be allowed to cause an overflow to occur in the collection sump. This would allow untreated water to flow to the main oil/water separator.

4.2 Truck Rack Spill Response/Bypass Prevention

In the event of a spill at the truck rack, care will be taken to insure that no spill residues or contaminated water are released to the facility's stormwater collection system. Small spills such as inadvertent spillage during tanker loading may be accommodated in the normal operation of the underground separator/spill containment tank - carbon treatment system. Larger spills, however, may generate large volumes of washwater and/or product which must be collected, segregated, and either specially treated on site or hauled off site for disposal.

For major spills, allow the material to pass through the underground separator/spill containment tank and be pumped to the equalization tank while the carbon filter transfer pump switch is in the "off" position. This will collect the waste in the equalization tank but prevent it from being transferred to the carbon filters and subsequently to the stormwater collection system. Portable tanks and/or vacuum tankers will be used, if required, to store contaminated water and spilled product.

The underground separator/spill containment tank will be checked for free product weekly or after any significant spill, per the procedure outlined in Section 3.4.2. Any significant product accumulation in the tank should be removed immediately (should be done after any significant spill).

4.3 Unanticipated Discharges

Shell's National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-000179-1 requires that Shell obtain approval in advance of discharging water from non-routine operations (e.g., tank hydrotesting). This authorization is issued by:

Washington State Department of Ecology
Northwest Regional Office
Water Quality-Industrial Section-WDIS
3190 - 160th Avenue S.E.
Bellevue, Washington 98008-5452

Prior to any such discharge, Shell will contact the Department and **at a minimum** provide the following information:

1. The nature of the activity that is generating the discharge.
2. Any alternatives to the discharge, such as reuse, storage, or recycling of the water.
3. The total volume of water expected to be discharged.
4. The results of the chemical analysis of the water. The water shall be analyzed for all constituents specified by Ecology.
5. The rate at which the water will be discharged, in gallons per minute.

Alternatively, a temporary discharge approval can be obtained from King County by contacting the King County Industrial Waste Section. They require analysis of the water for BTEX, lead,

oil and grease, and non-polar fats, oil, and grease. The data will be reviewed by King County, and a temporary authorization granted to discharge up to 25,000 gallons per day to the King County sewer system.

5.0 SAMPLING AND MONITORING

This section has been developed to ensure that sampling and monitoring will be conducted in accordance with the monitoring and sampling requirements identified in NPDES Permit No. WA-000179-1 for the Seattle Distribution Terminal. The sampling and monitoring procedures, laboratory requirements, and reporting requirements are presented below:

5.1 Sampling and Monitoring Procedures

The sampling and monitoring procedures are presented below by sampling interval. They will be implemented by a trained inspector/sampler. The sample type, the date, the exact place (e.g., Outfall 002), the time of sampling, and the sampler's name must be recorded for each measurement or sample taken. Specific reporting requirements are presented in the respective section of this plan.

5.1.1 Discharge Limit Exceedance

The laboratory analyzing samples from the separator will notify the terminal or its representative via telephone or e-mail if any sample result exceeds the established NPDES effluent limitations for oil and grease, total suspended solids, benzene, ethylbenzene, or zinc (see Table 2). If this occurs, the discharge should be closed (refer to Section 3.2.3), and a second sample should be collected and analyzed. If the second sample is within discharge limits, the discharge will be opened and the source of the exceedance investigated.

5.1.2 Daily Monitoring

The following will be done on a daily basis:

1. **Flow.** The manhole cover in the discharge pipe from the last compartment of the separator will be removed and whether or not flow is observed will be noted on the NPDES Monitoring Daily Log Form (Form ES-3). Rainfall at the terminal will be measured by reading the rain gauge. The rainfall will be recorded daily on Form ES-3. For reporting on the discharge monitoring reports, flow will be estimated from the daily rainfall measurements. The flow will be calculated and entered on the Discharge Monitoring Reports each quarter.
2. **Oil & Grease Visual Inspection.** The last compartment of the main oil/water separator and the sampling port in the third compartment of the small oil/water separator will be inspected for visible sheen. The date, time, inspector's initials, and whether or not sheen was observed will be recorded on the NPDES Monitoring Daily Log Form (Form ES-3).
3. **pH Grab Sample.** A grab sample will be collected from the last compartment of the main separator using a disposable polyethylene bailer. Some of the sample will be transferred to a clean jar. A pH measurement will be taken by using either pH paper or a pH probe. The probe will be calibrated before each use and cleaned at least weekly. The

date, the time, the results, and the sampler's initials will be recorded on the NPDES Monitoring Daily Log Form (Form ES-3).

5.1.3 Monthly Monitoring

All sampling will be conducted during discharge to the storm sewer. DISCHARGE is defined as measurable flow through the outlet of the separator. If there is no measurable flow during the entire month, then zero flow will be noted on the NPDES Monitoring Daily Log Form (Form ES-3), and no sample will be collected. Samples will be collected as early as possible each month (week 1 if possible) so that results from the laboratory will be received in a timely manner for reporting to Ecology. A note will be added to the chain-of-custody form indicating that the laboratory will report all results to the method detection limit (MDL) and will also list the method reporting limit (MRL or RL).

1. **Oil & Grease.** Samples will be collected from the last compartment of the main separator and the sampling port in third compartment of the small separator using a disposable polyethylene bailer. The containers will be filled as outlined in Table 3. The sample number, the date, the time, the laboratory parameter, the laboratory method, and the sampler initials will be recorded on the chain-of-custody form.
2. **Total Petroleum Hydrocarbons and BTEX.** Samples will be collected from the last compartment of the main separator using a disposable polyethylene bailer. The containers will be filled as outlined in Table 3. The sample number, the date, the time, the laboratory parameter, the laboratory method, and the sampler initials will be recorded on the chain-of-custody form. BTEX samples will be submitted on a 24-hour turnaround time basis.
3. **Total Zinc, Total Lead, and Total Copper.** Samples will be collected from the last compartment of the main separator by using a disposable polyethylene bailer. The containers will be filled as outlined in Table 3. The sample number, the date, the time, the laboratory parameter, the laboratory method, and the sampler initials will be recorded on the chain-of-custody form.
4. **Total Suspended Solids.** Samples will be collected from the last compartment of the main separator using an autosampler. The containers will be filled as outlined in Table 3. This sample will be an 8-hour composite consisting of four equal volume grab samples collected at 2-hour intervals (i.e., a 1 liter composite sample would contain four 250-milliliter grab samples). The sample number, the date, the time, the laboratory parameter, the laboratory method, and the sampler's initials will be recorded on the chain-of-custody form.
5. **Biochemical Oxygen Demand (BOD).** Samples will be collected from the last compartment of the main separator using an autosampler. The containers will be filled as outlined in Table 3. This sample will be a 24-hour composite sample composed of a series of individual samples combined into one sample for analysis. The sample number, the date, the time, the laboratory parameter, the laboratory method, and the sampler's initials will be recorded on the chain-of-custody form.

5.1.4 Infrequent Permit Monitoring

Per the permit, samples will be collected on an infrequent basis as follows:

1. **Once During the Permit Cycle.** Samples will be collected once during the permit cycle from the last compartment of the main separator and submitted to a laboratory for priority pollutant analysis. Samples will be collected during discharge (measurable flow through the outlet of the main separator) to the storm sewer. A disposable polyethylene bailer will be used to collect the samples. The containers will be filled for priority pollutant analyses as outlined in Table 3. Priority pollutant analyses include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and total metals (arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc). The sample number, the date, the time, the laboratory parameter, the laboratory method, and the sampler's initials will be recorded on the chain-of-custody form.
2. **Twice During the Permit Cycle.** Samples will be collected twice during the permit cycle from the main separator clearwell and submitted to a laboratory for acute and chronic toxicity testing. Samples will be collected during June and December 2013. A peristaltic pump or disposable polyethylene bailer will be used to collect the samples; the samples will be transferred to sample containers supplied by the selected laboratory and transported to the laboratory immediately after collection. The samples will be used in acute toxicity testing with fathead minnow (96 hour static renewal test) and daphnid (48 hour static test) and in chronic toxicity testing with topmelt and mysid shrimp.

5.2 Sample Storage and Shipment

A sample label must be filled out for all samples going to the laboratory. This information will be filled out using waterproof ink. The label will identify, at a minimum, the following information:

- Sample number (including month designation)
- Analyses to be performed
- Preservative added
- Sampler's name
- Date
- Facility's name

A chain-of-custody will be completed for each set of samples to be submitted to the laboratory for analyses. Standard laboratory analysis turn-around will be required for all analyses except for BTEX. The 24-hour turn-around will be clearly identified as a "special requirement" on the chain-of-custody for BTEX analyses. The sampler will retain one copy for the terminal's records. The signed form will be placed in a sealed plastic bag and taped to the inside lid of the cooler.

The sampler will pack the sample bottles in a cooler, using ice or blue ice to maintain cool temperatures (4°C) during transport. The bottles will be packed to ensure that breakage does not occur (e.g., cushioned with Styrofoam peanuts).

The sampler will deliver the samples directly to the laboratory upon completion of sampling, or the samples will be shipped via Federal Express. If samples are temporarily stored before they are driven to the laboratory or shipped, a custody seal will be affixed to the outside of the cooler and positioned so that the seal will break if the cooler is opened.

The samples must be transported to the laboratory in a timely manner so that analyses can be performed by the holding times outlined for the respective parameters in Table 3.

5.3 Reporting Requirements

For each measurement or sample taken, the following information must be recorded:

- The date, exact place (i.e., clearwell), method, and time of sampling
- The dates the analyses (if applicable) were performed
- Who performed the sampling and analyses
- The laboratory techniques or methods used
- The results of the analyses or monitoring

Monitoring results will be summarized and reported on a quarterly basis for monitoring results obtained during the previous three months.

The results will be submitted on a discharge monitoring report (DMR) form. With respect to visual inspection, the DMR will be filled out as follows:

- Circle the “yes” when visual sheen is observed during discharge conditions (i.e., measurable flow).
- Circle the “no” when no visual sheen is observed or when visual sheen is observed during “no discharge” conditions.

All DMRs will be checked for accuracy and to determine whether an apparent exceedance of effluent limits resulted from laboratory error, upsets, or other unusual or nonrepresentative conditions. Such circumstances must be noted on the DMR and/or further explained in an accompanying letter.

The DMR will be submitted to Ecology no later than the 15th day of the month following the completed reporting period at the following address:

Ms. Jeanne Tran
Department of Ecology, Northwest Regional Office
3190 160th Avenue SE
Bellevue, Washington 98008-5452

TABLES

Table 1
Periodic Inspections, Monitoring, and Maintenance
NPDES Waste Discharge Permit No. WA-000179-1
Shell Seattle Distribution Terminal

Task	Frequency	Purpose
Containment Areas		
Water surface observation	Prior to valve opening	Minimize oil in main oil/water separator
Drain and valve inspection	Quarterly	Check system integrity
Main Oil/Water Separator and Related Items		
Visual monitoring for sheen and flow	Daily	Check separator function and discharge status
Booms/absorbent pads observation	Daily	Determine need for boom/pad change and surface skimming
Measurement of pH and rain gauge	Daily	Document discharge conditions
Discharge sampling at Outfall 001	Monthly ¹	Document discharge conditions
Catch basin and drainage pipe inspection	Annually or as needed based on discharge results	Check for sediment accumulation
Catch basin sediment removal	When basin at least 60% full or within 6" of pipe	To minimize sediment transport to oil/water separator
Drainage pipe sediment removal	When pipe at least 1/3 full of sediment	To minimize sediment transport to oil/water separator
Rain gauge	As needed	Check rain gauge integrity
Sludge removal and structural integrity inspection	Approximately every 5 years, sooner if needed	Maintain capacity and efficiency; confirm separator integrity
Small Oil/Water Separator and Related Items		
Visual monitoring for sheen	Daily	Check separator function and discharge status
Booms/absorbent pads observation	Daily	Determine need for boom/pad change and surface skimming
Measurement of pH, discharge sampling at Outfall 002	Monthly	Document discharge conditions
Catch basin and drainage pipe inspection	Annually or as needed based on discharge results	Check for sediment accumulation
Catch basin sediment removal	When basin at least 60% full or within 6" of pipe	To minimize sediment transport to oil/water separator
Drainage pipe sediment removal	When pipe at least 1/3 full of sediment	To minimize sediment transport to oil/water separator
Sludge removal and structural integrity inspection	Approximately every 3 years, sooner if needed	Maintain capacity and efficiency; confirm separator integrity
Carbon Treatment System		
Controls inspection	Daily	Check system integrity
Truck pumpoff pad strip drain inspection	Daily	Check for product
Spill containment tank inspection	Weekly	Check product level in tank
Entire system inspection	Monthly	Check system integrity, functionality, and efficiency
Performance sampling	Every 6 months	Check need for carbon change-out
Stormwater (Zinc) Treatment System		
Performance sampling	Monthly	Check need for filter media change-out
Inspection and minor maintenance	Quarterly	Flow test pumps and remove vault debris
Inspection and event-based maintenance	After large storms or spills	Check system integrity and maintain system, as necessary
Major maintenance	As needed	Media replacement and sediment removal
Note: ¹ See permit and Sampling and Monitoring section of O&M manual for additional less frequent sampling required by the permit.		

Table 2

**Record of Major Maintenance
NPDES Waste Discharge Permit No. WA-000179-1
Shell Seattle Distribution Terminal**

Task/Work Performed	Date
Oil/water separators cleaned, inspected, and coated with epoxy	September 1995
Catch basins cleaned and inspected	September 1995
Tank 400 cleaned and inspected (per API-653)	October 1995
Drainage piping and catch basins cleaned and inspected	March 1998
Small oil/water separator cleaned, catch basins cleaned	Early 2001
Excelsior and calcium carbonate filter cages in main oil/water separator repaired	July 2004
Catch basins cleaned and inspected	August 2004
Main oil/water separator cleaned and inspected	September 2005
Main oil/water separator cleaned inspected, and modified to improved oil/water separation, stormwater storage, and stormwater treatment for zinc	October 2005
Tank 400 cleaned and inspected (per API-653)	October 2005
Load rack underground separator/spill containment tank tightness tested	November 2005
Small oil/water separator cleaned	August 2006
MetalRx filter cartridges replaced in Vault 1	November 2006
MetalRx filter cartridges in Vault 2 moved to Vault 1, cartridges with fresh MetalRx placed in Vault 2	September 2007
MetalRx filter cartridges in Vault 2 moved to Vault 1, cartridges with fresh MetalRx placed in Vault 2	November 2008
MetalRx filter cartridges in Vault 2 moved to Vault 1, cartridges with fresh MetalRx placed in Vault 2	January 2010
Last compartment of the main oil/water separator cleaned and inspected	February 2011
MetalRx filter cartridges replaced in Vault 1	May 2011
Main oil/water separator cleaned and inspected	June 2011
MetalRx filter cartridges replaced in Vault 2	July 2011
MetalRx filter cartridges replaced in Vaults 1 and 2, both vaults and underdrains cleaned, the last compartment of the main oil/water separator and the small oil/water separator cleaned, and the carbon treatment system expanded, with fresh carbon installed	July 2012
MetalRx filter cartridges replaced in Vaults 1 and 2, both vaults and underdrains cleaned, the entire main oil/water separator and entire small oil/water separator cleaned, and all of the catch basins and interconnecting pipes in the southern portion of the main terminal cleaned	January 2013

Table 3

Effluent Limits
NPDES Waste Discharge Permit No. WA-000179-1
Shell Seattle Distribution Terminal

Parameter	Average Monthly ^a	Maximum Daily ^b
Main Oil/Water Separator (Outfall 001)		
pH	Between the range of 6.5 and 8.5 standard units	
Oil and Grease	10 mg/L	15 mg/L
Oil and Grease	No oily sheen	
Total Suspended Solids (TSS)	21 mg/L	33 mg/L
Benzene	—	71 µg/L
Ethylbenzene	—	100 µg/L
Total Zinc	—	95 µg/L
Small Oil/Water Separator (Outfall 002)		
Oil and Grease	10 mg/L	15 mg/L
Oil and Grease	No oily sheen	
Notes		
— = effluent limitation not available		
^a The average monthly effluent limit is defined as the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured.		
^b The maximum daily effluent limit is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limits expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day. This does not apply to pH.		

Table 4

Summary of Analytical Methods, Containers, Preservatives, and Holding Times for Water Analyses
NPDES Waste Discharge Permit No. WA-000179-1
Shell Seattle Distribution Terminal

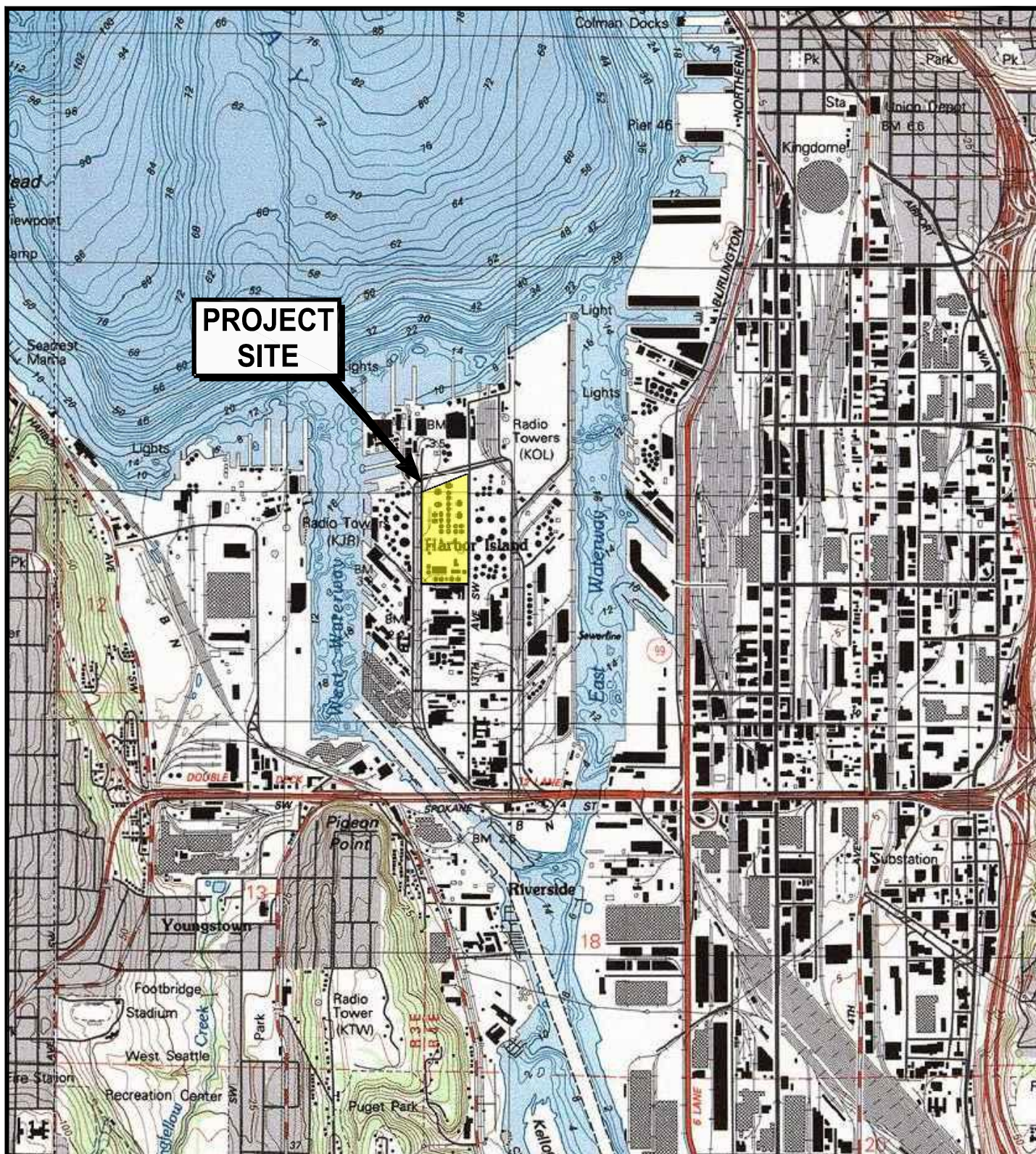
Analytes	Sample Type	Recommended Analytical Method	Guidance Levels in Permit		Water Container	Preservation	Handling	Maximum Holding Time
			MDL	MRL				
Outfall 001 – Daily Monitoring								
Flow	Estimate	–	–	–	–	–	–	–
Oily sheen	Visual	–	–	–	–	–	–	–
pH	Grab	EPA 150.1	–	–	–	–	–	–
Outfall 001 – Monthly Monitoring								
Oil & grease	Grab	EPA 1664A	–	5 mg/L	1-L amber glass	HCL, pH < 2	Cool (4°C)	28 days
TPH-G	Grab	NWTPH-Gx	–	–	2 x 40-mL VOA	HCL, pH < 2	No air space, dark, cool (4°C)	14 days
BTEX								
Benzene	Grab	EPA 8260	1.0 µg/L	2.0 µg/L	2 x 40-mL VOA	HCL, pH < 2	No air space, dark, cool (4°C)	14 days
Toluene	Grab	EPA 8260	1.0 µg/L	2.0 µg/L	2 x 40-mL VOA	HCL, pH < 2	No air space, dark, cool (4°C)	14 days
Ethylbenzene	Grab	EPA 8260	1.0 µg/L	2.0 µg/L	2 x 40-mL VOA	HCL, pH < 2	No air space, dark, cool (4°C)	14 days
Total xylenes	Grab	EPA 8260	–	–	2 x 40-mL VOA	HCL, pH < 2	No air space, dark, cool (4°C)	14 days
TSS	8-hr Comp	SM 2540-D	–	5 mg/L	1-L HDPE	None	H ₂ SO ₄ , pH<2	7 days
Total lead	Grab	EPA 200.8	0.1 µg/L	0.5 µg/L	500-mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Total zinc	Grab	EPA 200.8	0.5 µg/L	2.5 µg/L	500-mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Total copper	Grab	EPA 200.8	0.4 µg/L	2.0 µg/L	500-mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Biochemical oxygen demand (5-day)	24-hr Comp	SM 5210-B	–	2 mg/L	1-L amber glass	None	Cool (4°C)	24 hours
Outfall 001 – Once Per Permit Cycle								
Priority pollutants								
VOCs	Grab	EPA 624	1.0 µg/L (varies)	2.0 µg/L (varies)	3 x 40-mL VOA	HCL, pH < 2	No air space, dark, cool (4°C)	14 days
SVOCs	Grab	EPA 625	0.5 µg/L (varies)	1.0 µg/L (varies)	1-L amber glass	None	Cool (4°C)	7 days
PCBs	Grab	EPA 608	0.25 µg/L (varies)	0.5 µg/L (varies)	1-L amber glass	None	Cool (4°C)	7 days
Total Metals								
Arsenic	Grab	EPA 200.8	0.1 µg/L	0.5 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Cadmium	Grab	EPA 200.8	0.05 µg/L	0.25 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Copper	Grab	EPA 200.8	0.4 µg/L	2.0 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Lead	Grab	EPA 200.8	0.1 µg/L	0.5 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Mercury	Grab	EPA 1631E	0.0002 µg/L	0.0005 µg/L	250 mL Teflon/lined	HNO ₃ , pH < 2	Cool (4°C)	28 days
Nickel	Grab	EPA 200.8	0.1 µg/L	0.5 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Silver	Grab	EPA 200.8	0.04 µg/L	0.2 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Zinc	Grab	EPA 200.8	0.5 µg/L	2.5 µg/L	500 mL HDPE	HNO ₃ , pH < 2	Cool (4°C)	28 days
Outfall 001 – Twice Per Permit Cycle (June and December 2013)								
Acute Toxicity Testing								
Fathead minnow 96-hr static renewal	Grab	EPA-821-R-02-012	–	–	Plastic carboy	None	Cool (4°C)	–
Daphnid 48-hr static	Grab	EPA-821-R-02-012	–	–	Plastic carboy	None	Cool (4°C)	–
Chronic Toxicity Testing								
Topsmelt survival and growth	Grab	EPA/600/R-95/136	–	–	Plastic carboy	None	Cool (4°C)	–
Mysid shrimp survival and growth	Grab	EPA-821-R-02-014	–	–	Plastic carboy	None	Cool (4°C)	–

Table 4

**Summary of Analytical Methods, Containers, Preservatives, and Holding Times for Water Analyses
NPDES Waste Discharge Permit No. WA-000179-1
Shell Seattle Distribution Terminal**

Analytes	Sample Type	Recommended Analytical Method	Guidance Levels in Permit		Water Container	Preservation	Handling	Maximum Holding Time
			MDL	MRL				
Outfall 002 – Daily Monitoring								
Flow	Estimate	–	–	–	–	–	–	–
Oily sheen	Visual	–	–	–	–	–	–	–
Outfall 002 – Monthly Monitoring								
Oil & grease	Grab	EPA 1664A	–	5 mg/L	1-L amber glass	HCL, pH < 2	Cool (4°C)	28 days
pH	Grab	EPA 150.1	–	–	–	–	–	–
Notes: 1. MDL = method detection limit 2. MRL = method reporting limit 3. EPA = Environmental Protection Agency, NW = Ecology Northwest Method, SM = Standard Methods 4. Estimate = flow estimate from daily rainfall data 5. – = not available or not applicable 6. Comp = composite 7. HDPE = high density polyethylene								

ILLUSTRATIONS



0 2000 4000
Scale in Feet



U.S.G.S. Topo Maps - Seattle South W and Seattle South E, Washington,
7.5-minute quadrangles. 1978 photorevised 1983.



PES Environmental, Inc.
Engineering & Environmental Services

Site Location Map
Shell Seattle
Distribution Terminal
Seattle, Washington

FIGURE

1

828.001.01.003 82800101003_1-6

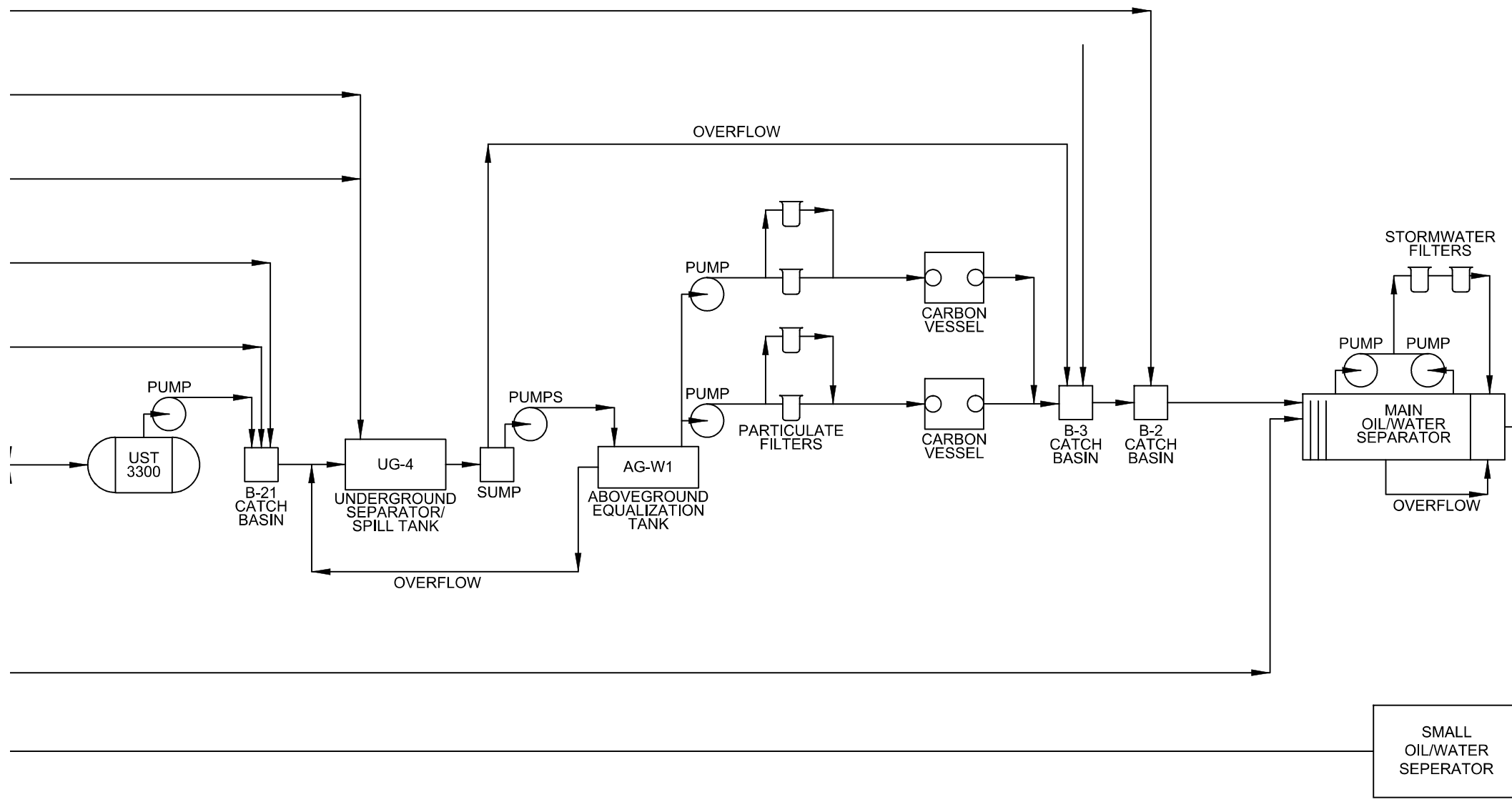
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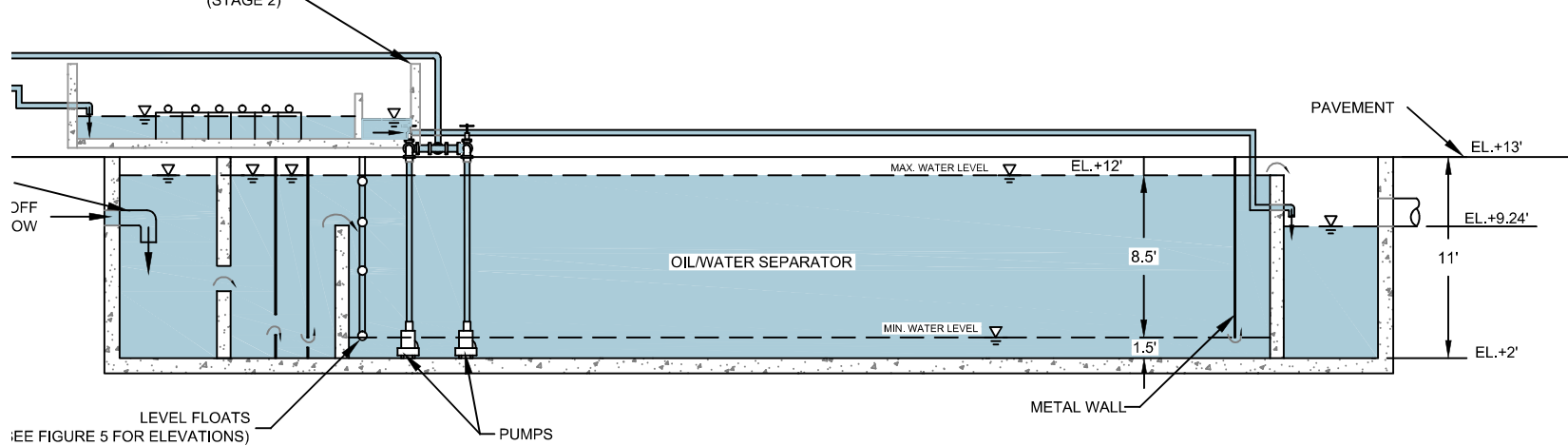
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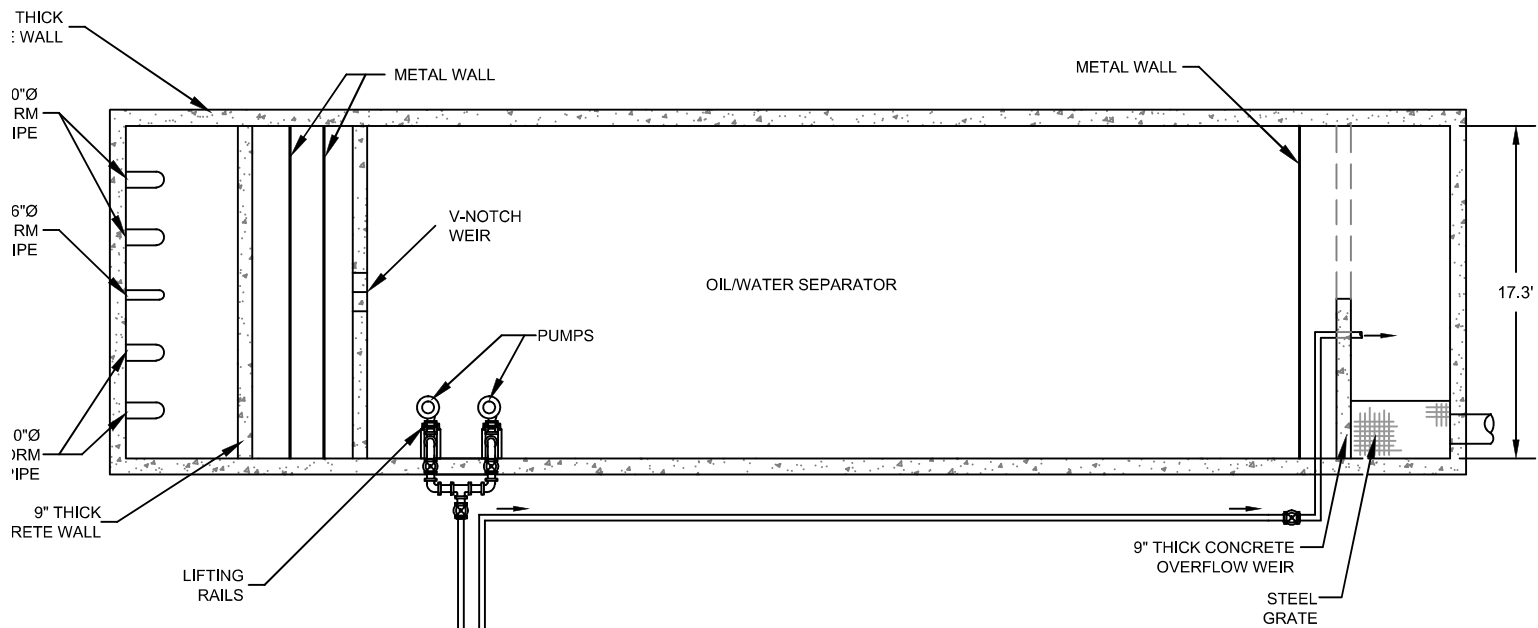
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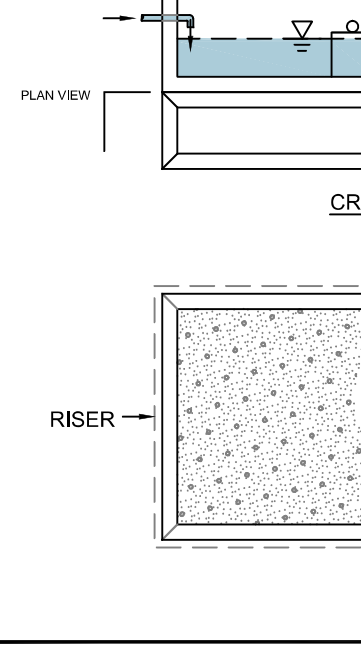




CROSS SECTION



PLAN VIEW



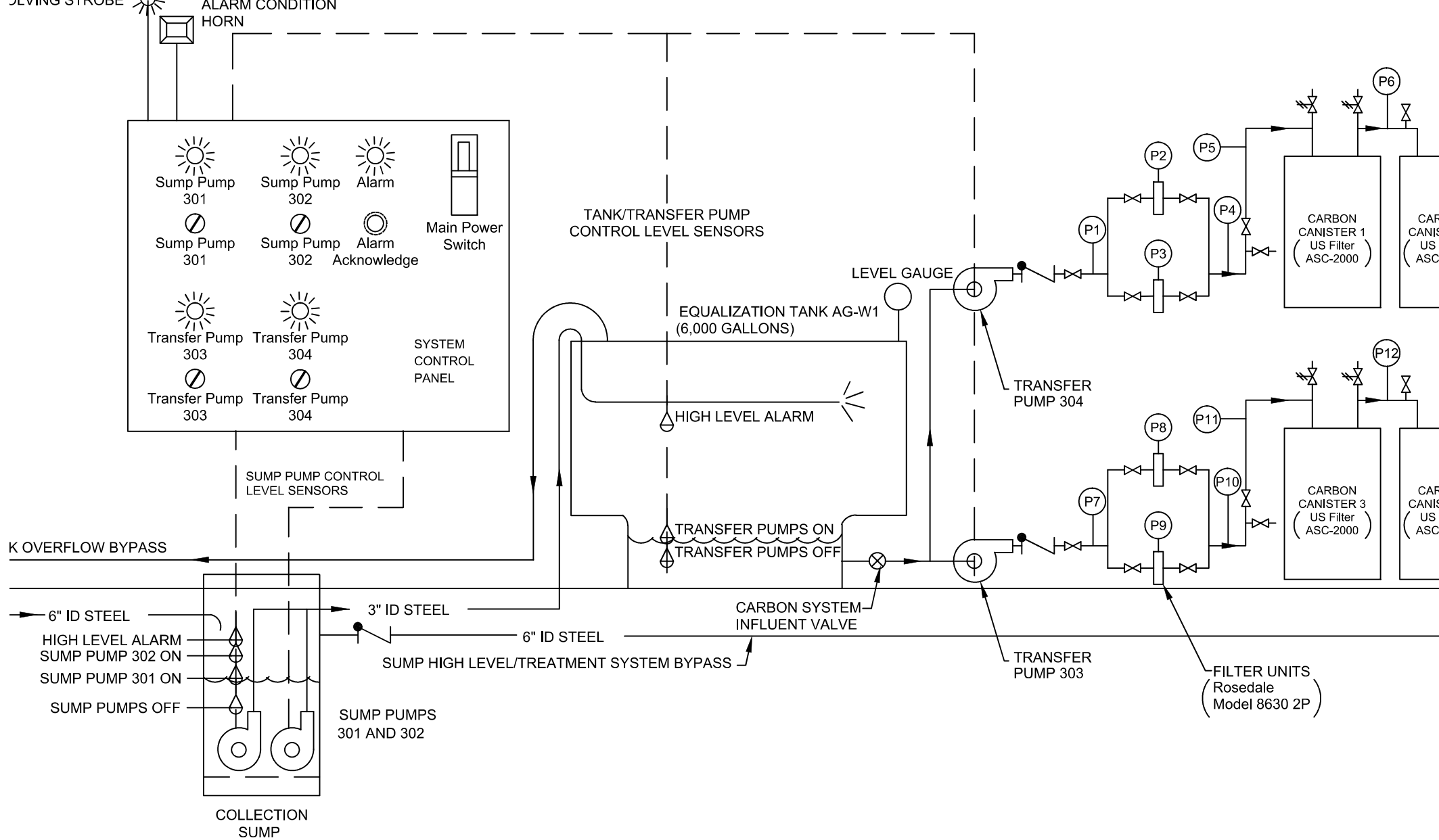
TOTAL SURGE CAPACITY

-OWS (at EL +12') = 58,000 gal.*

-STORM DRAIN = 11,000 gal.

-ON-SITE BONDING = 20,000 gal.

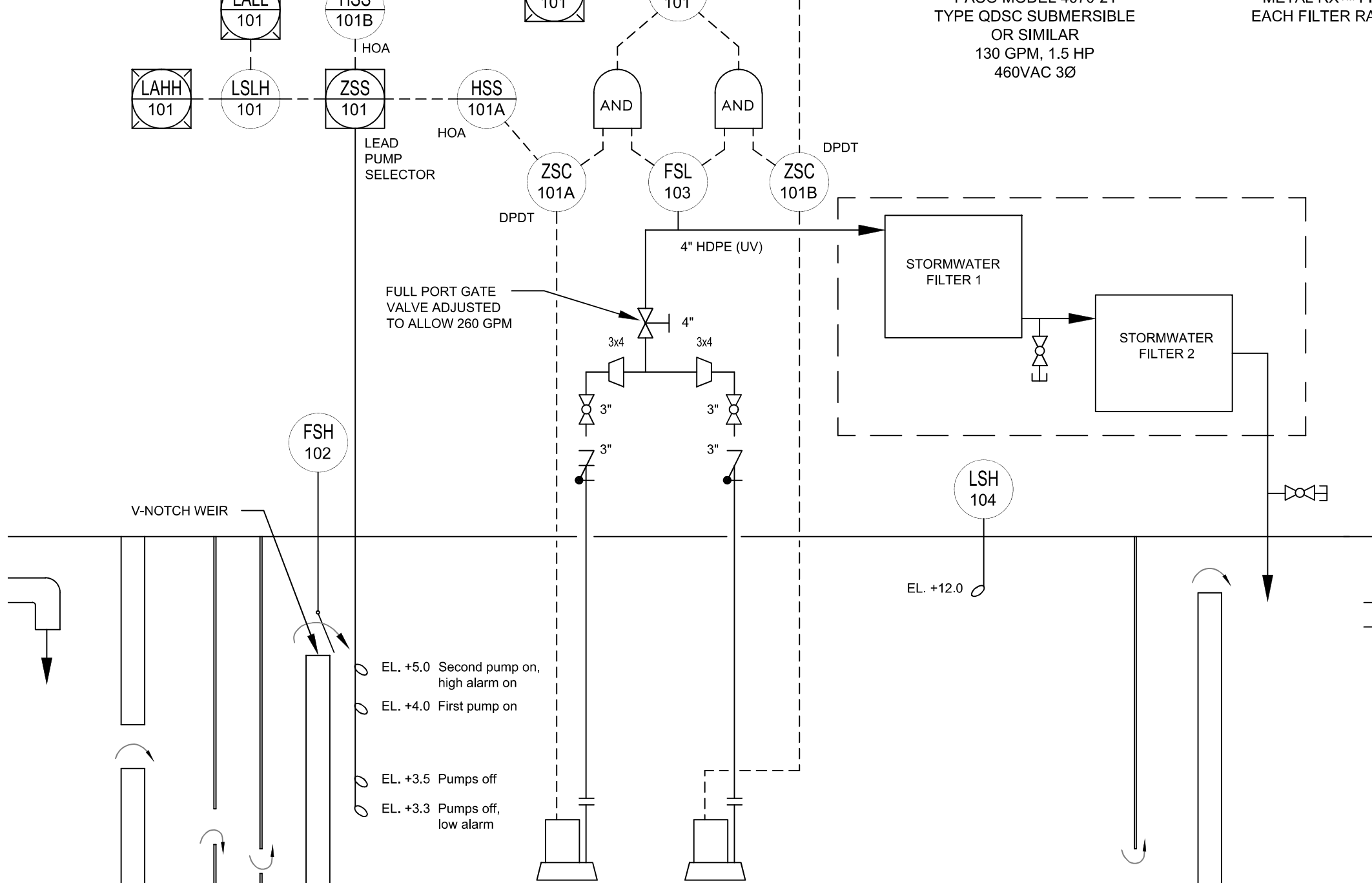




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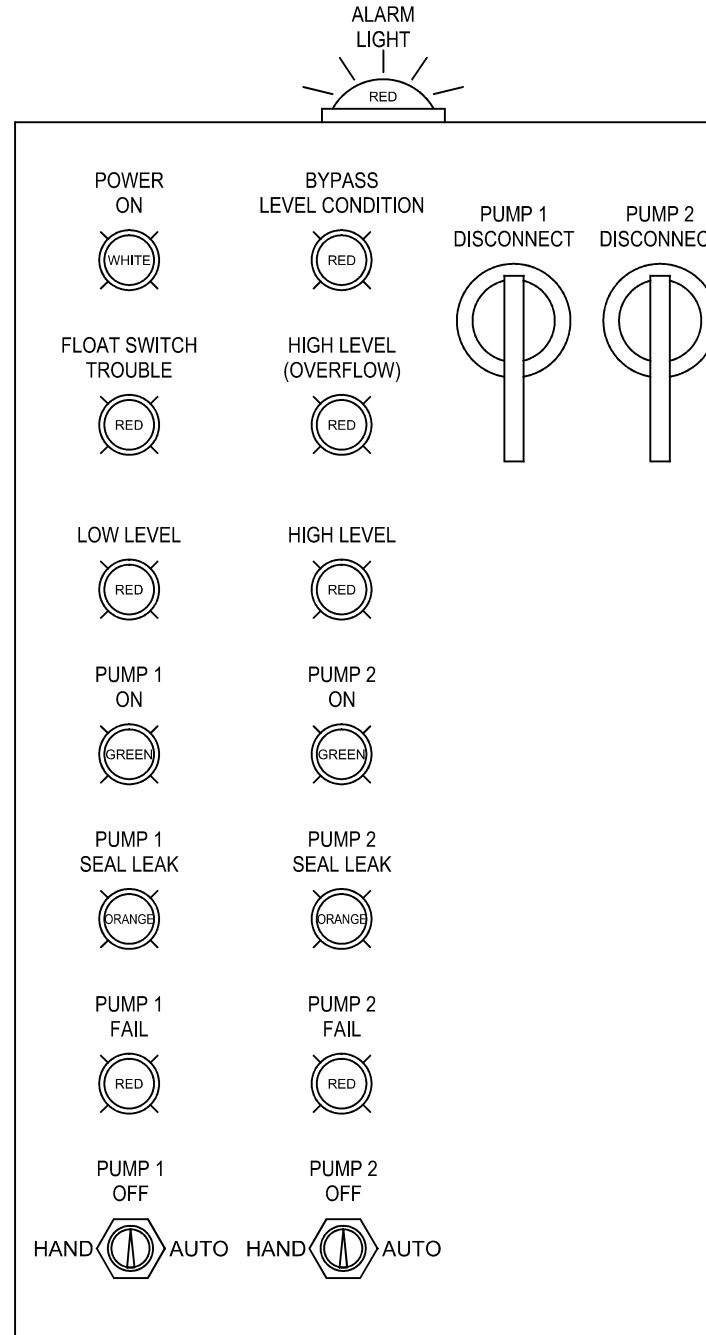
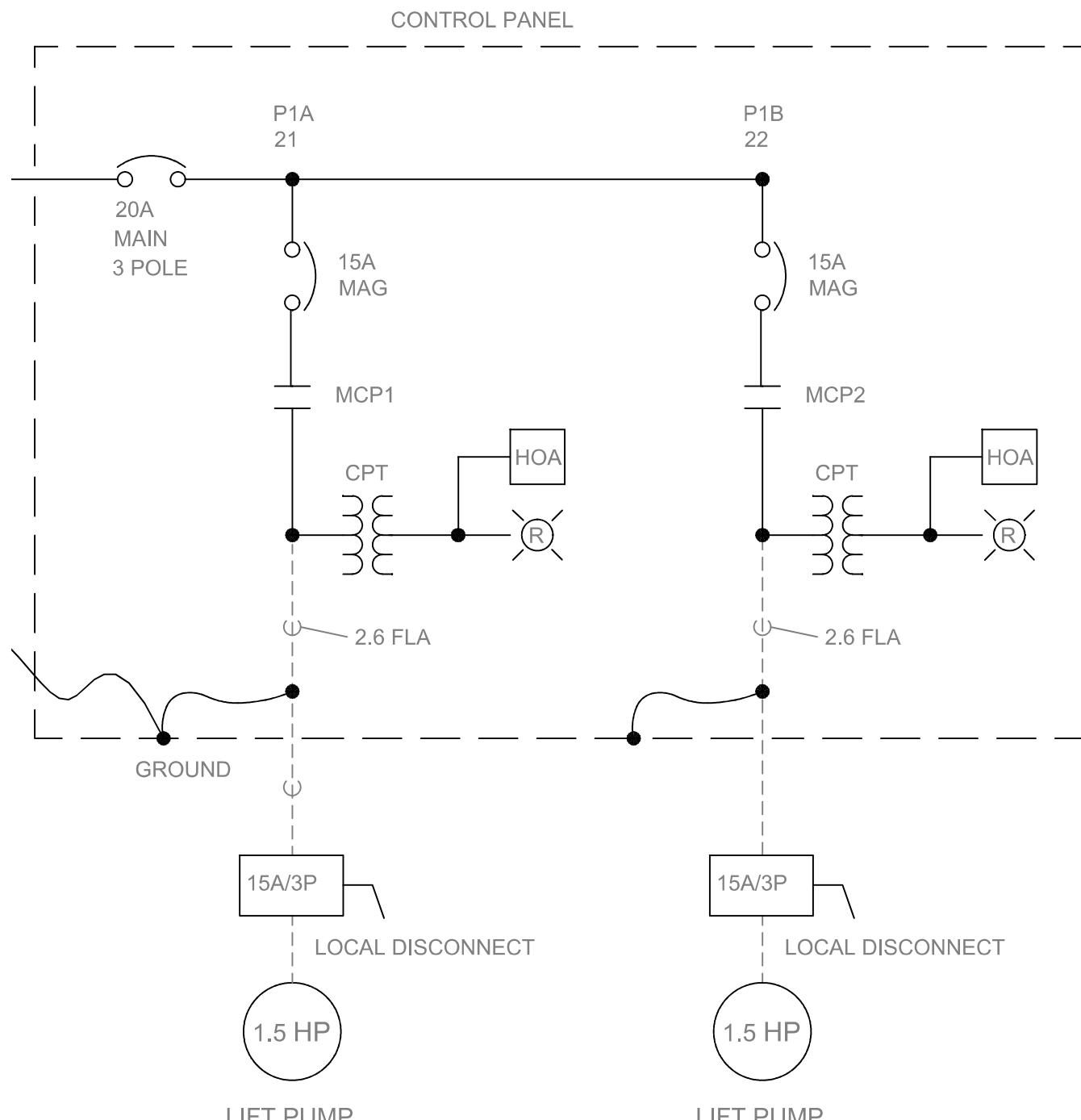


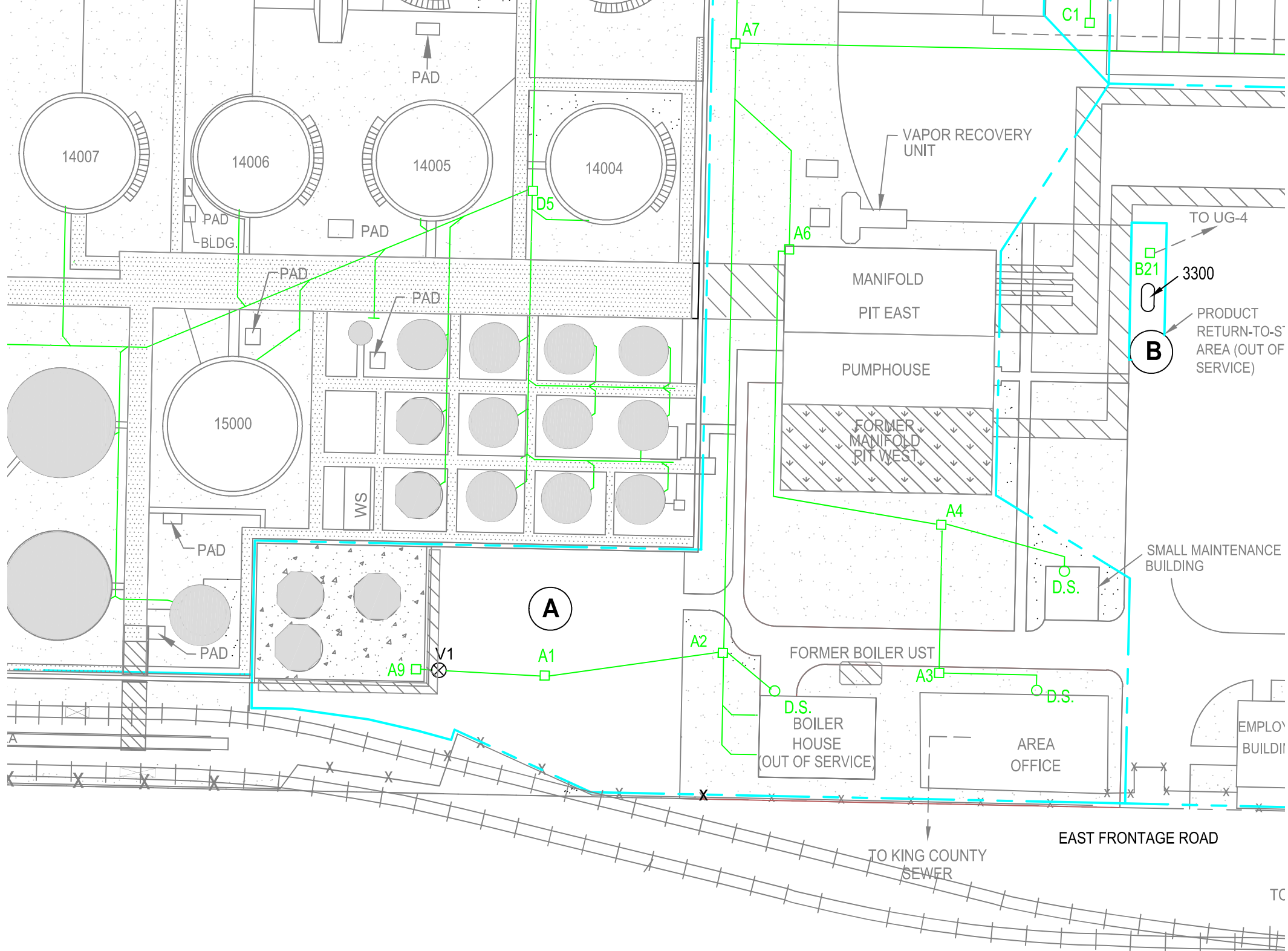


F FLOW SWITCH
 LEVEL SWITCH TREE
 WARNING LIGHT
 ARM LIGHT
 OR RELAY
 SELECTOR SWITCHES



60 Hz





APPENDIX A

FORMS

FORM ES-1

DIKE DRAIN REPORT SHELL SEATTLE TERMINAL

Date: _____

Area: _____ Main Tank Farm (valve 2)

Types of product stored within the dike: Gasolines, Distillates, Additives, Ethanol

Dike drain Inspected by:	Time dike drain Valve opened:	Time dike drain Valve closed:
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Contamination found?	_____ Yes	_____ No	_____ Date & Time
----------------------	-----------	----------	-------------------

Water sample taken?	_____ Yes	_____ No	_____ Date & Time
---------------------	-----------	----------	-------------------

Results received?	_____ Yes	_____ No	_____ Date & Time
-------------------	-----------	----------	-------------------

Comments: _____

Manager Signature: _____

**** MANAGEMENT APPROVAL NEEDED BEFORE OPENING ANY VALVES ****

FORM ES-2

**QUARTERLY DIKE DRAIN INSPECTION
SHELL SEATTLE TERMINAL**

Reference: O&M Manual Section 3.1

Valve Number	Valve Location	Valve Locked?	Does Valve Operate Easily?	Valve Inlet Free of Debris?	Valve Inlet Free of Silt?	Paint Condition	Comments
1	Additive pump off area	Yes No	Yes No	Yes No	Yes No	Good Fair	
2	BOL shack (main tank farm valve)	Yes No	Yes No	Yes No	Yes No	Good Fair	
Please list any other condition found that may need attention to ensure a clean and safe dike draining operation:							
Inspector's Signature:					Date:		

FORM ES-3
NPDES MONITORING DAILY LOG FORM, SHELL SEATTLE TERMINAL

Month: _____ Year: _____

Conduct the following inspections or measurements daily unless noted otherwise See reverse side for notes

Day	Time	MAIN SEPARATOR				Rain Gauge Upright and Clear? (Note 4)	Small Separator (monthly) pH (6.5 - 8.5) (Note 5)	SPILL CONTAINMENT TANK (weekly)				Carbon System Controls on and in Auto? (Note 7)	Sampler's Initials (Note 9)	Comments
		Oily Sheen Observed in Last Bay? (check one) (Note 1)	pH at Outfall (6.5 - 8.5) (Note 2)	Temp	Flow? (y / n) (Note 3)			Total Liquid Height (inches) (Note 6)	Height of Water (inches) (Note 6)	Product Thickness (inches) (Note 6)	Was Product Transferred? (Note 6) (check one)			
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24		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
25		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
26		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
27		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
28		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
29		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
30		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		
31		<input type="checkbox"/> y <input type="checkbox"/> n									<input type="checkbox"/> y <input type="checkbox"/> n	<input type="checkbox"/> y <input type="checkbox"/> n		

NOTES:

- 1 Outfall 001 - Visual Appearance: Check the last bay for oil, sheen, discoloration or abnormal conditions daily. If sheen is observed in the last bay, circle "yes," and immediately notify the Operations Supervisor or Terminal Manager to take corrective actions. If no sheen is observed, circle "no." Check the entire separator for abnormal conditions and to determine if absorbent pads or booms need to be replaced. Notify the Operations Supervisor or Terminal Manager in the event of any abnormal conditions.
- 2 Outfall 001 pH: This pH reading is required by the permit to be measured daily in the main oil/water separator and shall be taken at the designated outfall sampling point in the last compartment of the separator (near the discharge pipe). **Note, the permit requires the pH at the Outfall to be no less than 6.5 and no greater than 8.5.**

*** If this is NOT the case, the operator should do the following: collect a fresh sample and retake the pH readings at the Outfall. If the situation still exists, replace the meter batteries, clean and recalibrate the pH meter, collect a fresh sample, and retake the pH reading. If the situation continues, notify the Terminal Manager to contact PES Environmental to assist with additional readings using a different meter and investigate possible sources of the problem. If the situation cannot be resolved, and the Outfall pH is outside of the acceptable range, the Terminal Manager will be notified immediately.

Outfall 001 Temperature: This temperature of the water will be measured daily in the last compartment of the main oil/water separator near the discharge pipe.
- 3 Outfall 001 Flow: Remove the manhole cover in the discharge pipe from the last compartment of the separator and note if water is flowing in the pipe.
- 4 Rain Gauge: Check as needed to make sure that the rain gauge is in an upright position and that nothing is blocking the top of the rain gauge.
- 5 Small Separator - pH: Measure the discharge pH monthly.
- 6 Spill Containment Tank - Weekly Check:
 - (a) Gauge product thickness and record all data in inches
 - (b) Indicate if product was transferred from the tank by circling "yes" or "no" as applicable
- 7 Carbon System - Daily Check:
 - (a) Main power switch should be in the "on" position
 - (b) Sump pump and transfer pump switches should be in the "auto" position
 - (c) Alarm light should not be on.
- 8 Truck Pumpoff Pad Strip Drain and Sump: Check the strip drain daily to make sure that no biofuels have been spilled. Circle "yes" or "no" as applicable. Check the underground emergency spill containment tank monthly for product, noting "yes" or "no" as applicable.
- 9 **If any unusual condition is observed, sampler should immediately notify the Terminal Manager.**

FORM ES-4

CARBON TREATMENT SYSTEM INSPECTION LOG SHELL SEATTLE TERMINAL

System Component	Status ¹	Hand Test ²	Comments/Recommendations
Truck Load Rack Strip Drains	Note condition:		
Main Power Switch (On)	On / Off	—	
Pump Switch Lights	On / Off	—	
Sump High Level Alarm Light	On / Off	—	
Eq. Tank High Level Alarm Light	On / Off	—	
Sump Pump 301	Auto / Hand / Off		
Sump Pump 302	Auto / Hand / Off		
Sump Pump Level Switches	On / Off		
Equalization Tank ³ (Inches to Empty-ITE)			
Transfer Pump (304 [south])	Auto / Hand / Off		
Transfer Pump (303 [north])	Auto / Hand / Off		
Tank Effluent Valve Position	___ turns open	(___ turns is full open)	
Carbon 1 & 2 (East)			
Influent Pressure (P1) ⁵			
Filter Unit 1 (P2)			
Filter Unit 2 (P3)			
Filter Effluent Pressure (P4) ⁵			
Carbon Influent Valve Position	Open / Closed		
Carbon 1 Influent Pressure (P5) ⁶			
Carbon 2 Influent Pressure (P6) ⁶			
Carbon Effluent Valve Position	Open / Closed		
Carbon 3 & 4 (West)			
Influent Pressure (P7) ⁵			
Filter Unit 3 (P8)			
Filter Unit 4 (P9)			
Filter Effluent Pressure (P10) ⁵			
Carbon Influent Valve Position	Open / Closed		
Carbon 2 Influent Pressure (P11) ⁶			
Carbon 2 Influent Pressure (P12) ⁶			
Carbon Effluent Valve Position	Open / Closed		
Carbon Effluent Flow Rate (GPM) ⁴			
Flow Totalizer Reading (gallons)			
Number of Spare Particulate Filters			
Heat Trace Inspection	Note Condition:		

Inspector: _____

Date: _____

Notes

1. Document alarm light status, control switch positions, pressure gauge readings, and component breakage/malfunction.
2. Hand test all pumps by verifying operation when turning the control switch to "hand". Hand test collection level switches by manual activation.
3. Monitor proper operation of equalization tank level switches during high flow events.
4. Monitor totalizer for 1 - 2 minutes of operation to document carbon effluent flow rate.
5. If the pressure differential between filtration housing influent and effluent flows is >15 psi, consult O&M Manual Troubleshooting Section 3.3.3.
6. If the pressure is >12psi at either the carbon influent or intermediate gauges, consult O&M Manual Troubleshooting Section 3.3.3.

DAILY TERMINAL INSPECTION PAGE 1



TERMINAL INSPECTION FOR THE WEEK OF: _____

		Day	Time	Insp'td by	Temp.	Wind Direct	Weather
Meters	(CK for Leaks)	Sunday					
Loading Arms/Heads	(CK for Leaks)	Monday					
VR Hoses/Drains	(CK for Leaks)	Tuesday					
Additive Packs	(CK for Leaks)	Wednesday					
Strip Drains	(Not plugged or backed up)	Thursday					
		Friday					
		Saturday					

Comments: _____

Tank Farm

		Day	Time	Insp'td by
Tanks	(Ck for leaks and product level)	Sunday		
Piping	(Ck for leaks and paint conditional)	Monday		
Pumps & Seals	(Ck for leaks and unusual noise)	Tuesday		
Water Draws	(Closed/Locked)	Wednesday		
Ground WTR monitoring wells	(Closed/Locked)	Thursday		
Dike Drains	(Closed/Locked)	Friday		
Haz Waste Storage	(Closed/Locked/Leakers)	Saturday		
UG Tank	(CK for Leaks)			

Comments: _____

Safety/Security Inspection

		Day	Time	Insp'td by
Fenceline	(Ck for breaks in fence or barbed wire and Holes)	Sunday		
Gates	(Operate properly/Closed and Locked)	Monday		
Lighting	(Ck to see that all yard lights are operational)	Tuesday		
Leak detector	(Ck lights)	Wednesday		
		Thursday		
		Friday		
		Saturday		

Comments: _____

Storm Water

		Day	Time	Insp'td by	Oily Sheen in Clear Well Yes/No	If Yes report to Manager immediately
Tank Farm		Sunday				
Terminal Yard		Monday				
Storm Drains / Discharge Points		Tuesday				
(check for spills, leaks, uncontrolled pollutant sources & implement appropriate corrective action, valves closed and locked) Check Small Separator for Oily Sheen in all bays and Absorbant pad in good condition in final bay <u>Check PH</u> and Record on Form		Wednesday				
		Thursday				
		Friday				
		Saturday				

Comments: _____

Dehumidifier

		Day	Time	Insp'td by
Check warm air blowing from reactivation air outlet		Sunday		
Check for any fault lights on Bry-Air electrical panel		Monday		
Check process air humidity level - read panelview on storeroom cabinet		Tuesday		
Press F1 - Read bottom line - Press F1		Wednesday		
Reading should be <15% RH		Thursday		
		Friday		
		Saturday		

Comments: _____

Bio Recirculation Heater

		Day	Time	Insp'td by	Recirc Press	14004 Temp
Inspect for damage or leaks		Sunday				
Listen for unusual noises		Monday				
Record incoming pressure into recirculation heater		Tuesday				
Verify heater Overtemp lamp is not illuminated		Wednesday				
Record 14004 temperature readings		Thursday				
		Friday				
		Saturday				

Comments: _____

APPENDIX B

INSTRUMENT MANUALS



INSTRUCTION MANUAL

pHTestr 10, 20, 30, 10BNC, Spear

Large Screen
Waterproof pH / Temperature Testr
Double Junction

Introduction

Thank you for selecting our waterproof pH Testr. This manual serves the following 5) models:

pHTestr 10	(Eutech PHTEST10 / 01X366901 / Oakton 35634-10)
pHTestr 20	(Eutech PHTEST20 / 01X366902 / Oakton 35634-20)
pHTestr 30	(Eutech PHTEST30 / 01X366903 / Oakton 35634-30)
pHTestr 10BNC	(Eutech PHTEST10BNC 01X366904 / Oakton 35634-14)
pH Spear	(Eutech PPHSPEAR 01X366920 / Oakton 35634-40)

This manual provides a step-by-step guide to operate the Testrs.

Before you begin:

Condition your pHTestr 10, 20, 30 electrodes by immersing it in electrode storage solution in tap water for at least 30 minutes before use. DO NOT use de-ionized water.

Ensure that your pHspear electrode is always soaked in the electrode storage solution or tap water via its protective cap.

Note: For pHTestr 10BNC, please refer to the pH electrode's instruction manual.

Buffer Set Selection

Your Testr features USA (pH 4.01, pH 7.00 and pH 10.01) or NIST (pH 4.01, pH 6.86, and pH 9.18) standards. Select either one to suit your requirements.

1. While pressing the HOLD/ENT button, switch on the Testr by pressing the ON/OFF button.
2. Release the HOLD/ENT button. The display will flash either USA or NIST.
3. Press CAL button to toggle between the two buffer set standards.
4. Press the HOLD/ENT button to confirm the selection of the buffer set.

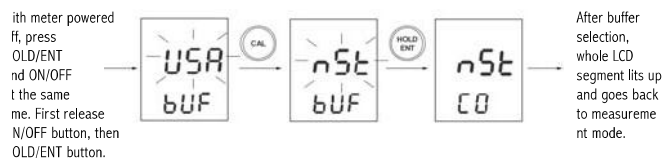


Figure 1: Buffer Selection Sequence

High Calibration

Calibration should be done regularly, preferably once a week. You can calibrate up to three points using either the USA or the NIST buffer set standards.

1. Press ON/OFF button to switch unit on.
2. Dip electrode about 2 to 3 cm into the pH standard buffer solution.

3. Press the CAL button to enter calibration mode. The 'CAL' indicator will be shown. The upper display will show the measured reading based on the last calibration while the lower display will indicate the pH standard buffer solution.

Note: All Testrs have dual display during calibration mode

Note: To abort calibration, press the 'CAL' button.

4. Allow about 2 minutes for the Testr reading to stabilize before pressing the HOLD/ENT button to confirm the first calibration point. The upper display will be calibrated to the pH standard buffer solution and the lower display will then be toggling in between readings of the next pH standard buffer solution.
5. Repeat with other buffers if necessary. Rinse electrode in tap water before dipping into next buffer.

Note: The calibration mode allows you to perform up to three calibration points before returning to the measurement mode automatically. However, if you opted to have only one or two calibration points, simply skip the remaining calibration points by exiting to the measurement mode by pressing the CAL button.

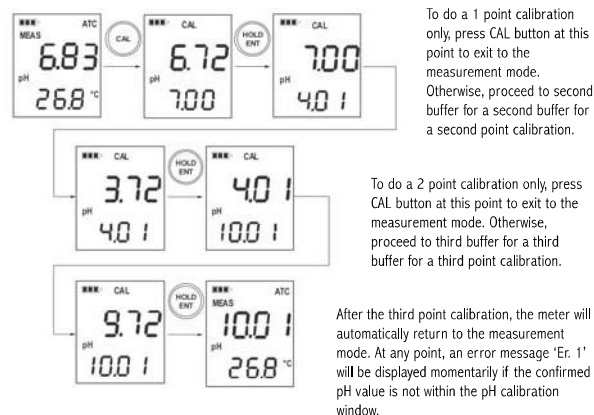


Figure 2: Example of pH Calibration Sequence

pH Measurement

1. Press the ON/OFF button to switch the Testr on.
2. Dip the electrode about 2 to 3 cm into the test solution. Stir and let the reading stabilize. For semi-solid samples using pHspear, rotation is ideal for sample contact. CAUTION: Testing dry samples is not accurate and can lead to sensor damage or breakage. Soils must be wet and free of particulates that may scratch the glass sensor. Excessive force into dry samples can cause glass breakage.
3. Note the pH value or press HOLD/ENT button to freeze the reading. To release the reading, press HOLD/ENT again.
4. Press ON/OFF to turn off Testr. If you do not press a button for 8.5 minutes, the Testr will automatically shut off to conserve batteries.

HOLD Function

This feature lets you freeze the display for a delayed observation

1. Press HOLD/ENT button to freeze the measurement. A 'HOLD' indicator will be displayed and the measurement will be frozen.
2. Press HOLD/ENT again to release the measurement. The 'HOLD' indicator will not be displayed anymore indicating the held measurement is released.



Figure 4: Example of HOLD Function

User Reset

You can reset the pH calibration to the factory default by using the user reset function. Buffer set selection and temperature user calibration (pHTestr30) are not affected by the user reset function.

1. Switch off the Testr.
2. While pressing the 'CAL' button, press and release the ON/OFF button to enter the 'User Reset' selection menu. The screen will display 'rSt' on the bottom display with a flashing 'nO' selection.
3. Use the 'CAL' button to toggle between 'nO' and 'YES' selection.
 - nO deactivates reset selection
 - YES activates the reset selection
4. Press the HOLD/ENT button to confirm the selection made.
5. If you have selected 'YES', the unit will show 'CO' momentarily and proceed to the measurement mode with the calibration reset back to factory default value.
6. If 'nO' is selected, the unit will proceed to the measurement mode without any calibration reset performed.



Figure 5: User Reset Sequence

ATC - Automatic Temperature Compensation (Only for pHTestr 10, pHTestr 20 and pHTestr 30)

Through its in-built temperature sensor, the measurement error due to the changes in electrode sensitivity due to changes in temperature is compensated to give the actual pH reading of the sample measured.

MTC - Manual Temperature Compensation (Only for pHTestr 10BNC, pH Spear)

The MTC range is 0 to 50.0 °C (32.0 to 122.0 °F). User reset will set temperature to default value 25°C or 77°F.

While in the measurement mode,

1. Press the HOLD/ENT button to bring the Testr to the 'HOLD' mode.
2. Press the CAL button continuously to switch to the °C or °F mode setting selection screen.
3. Release the CAL button to confirm your mode selection and the display will go to the manual temperature calibration mode with the upper display flashing. The upper display shows the adjustable temperature value and the lower display shows the last set temperature offset.
4. Press the HOLD/ENT button to set the upper display to the temperature value of your sample.
5. Once the setting is reached, release the HOLD/ENT button. The new value is automatically confirmed and returns to the measurement mode if no button is pressed after 5 seconds.

Notes: To exit this program without confirming the calibration, press the CAL button before the automatic confirmation takes place.

Temperature Calibration (Only for pHTestr 30)

From the measurement mode,

1. Press the HOLD/ENT button to bring the Testr to the 'HOLD' mode.
2. Press the CAL button for 3 seconds to switch to the °C or °F mode setting selection screen. Pressing the CAL button continuously for 3 seconds allows you to toggle in between the °C and °F mode setting selection screen.
3. Release the CAL button to confirm your mode selection and the display will go to the temperature calibration mode with the upper display flashing. The upper display shows the current measured temperature reading based on the last set offset and the lower display shows the current measured temperature reading based on factory default calibration.
4. Dip the Testr into a solution of known temperature and allow time for the in built temperature sensor to stabilize.
5. Press the HOLD/ENT button to set the upper display to the temperature value of the solution.
6. Once the new temperature setting is reached, the new value is automatically confirmed and returns to the measurement mode if no button is pressed after 5 seconds.

Notes: To exit this program without confirming the calibration, press the CAL button before the automatic confirmation takes place.

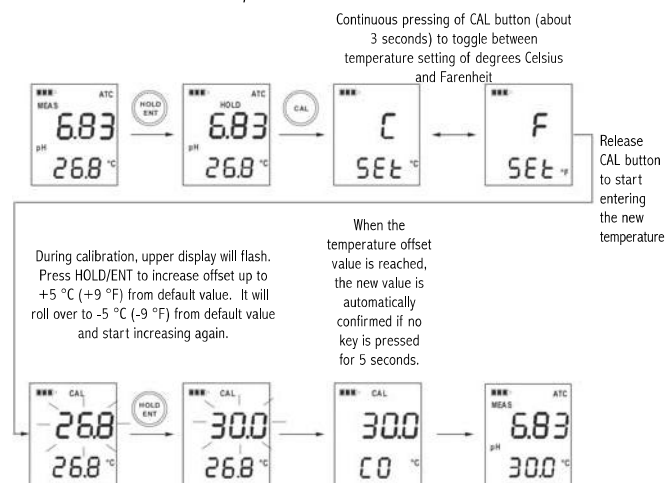


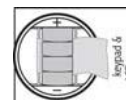
Figure 6: Temperature Calibration Sequence (Only for pHTestr 30DI)

Electrode Maintenance

1. Before measuring soil pH with the pHSpear, wet your soil sample with distilled water and ensure that the soil is free of particulates. Even though the pHSpear is ruggedized, hard surfaces such as stones and pebbles can still cause breakage.
2. Rinse the electrode with tap water or electrode storage solution after each measurement. Care has to be taken not to damage the sensor's glass electrode especially while rinsing the pHSpear penetrating tip electrode.
3. In aggressive chemicals, dirty or viscous solutions, and solutions with heavy metals or proteins, take readings quickly and rinse electrode immediately afterward. For the pHSpear, the remnants of the semi solid samples on the penetrating electrode can be removed by rubbing it with some table salt and then rinsing. Mild detergent can be used to wash the penetrating electrode clean.
4. If possible, keep a small piece of paper or sponge in the electrode cap — moistened with clean water or electrode storage solution (NOT de-ionized water) — and close the cap over the electrode. For pHSpear, ensure that the electrode is kept soaked in electrode storage solution or tap water via its protective cap.

Changing Batteries

1. Open battery compartment lid (with attached lanyard loop).
2. Remove old batteries; replace with fresh ones. Note polarity



Self-Diagnostic Messages

Low battery indicator		3 Bars indicates Battery is full (100%)
		2 Bars indicates 50% of the battery life is left
		1 Bar indicates 25% of the battery life is left
Over range / Under range signal		Blinking battery casing indicates the need to replace batteries with fresh ones as specified by manufacturer
	Or / Ur (Still)	Electrode is not in contact with solution or electrode is failing. Replacement sensor is not connected properly to the tester during sensor replacement
	ATC / Or / Ur (Blinking)	Measured pH value or temperature value (pHTestr30) exceeds its specified maximum or minimum value
Error Message	Er.0	Temperature calibration error of attempting to calibrate tester to a value which is out of range or under range
	Er.1	pH calibration error of attempting to confirm a calibration value which is not within the specified calibration window

Electrode Replacement

You can replace the electrode module at the fraction of the cost of a new Testr. When the tester fails to calibrate or gives fluctuating readings in calibration standards, you need to change the electrode.

1. With dry hands, grip the ribbed Testr collar with electrode facing you. Twist the collar counter clockwise (see picture A). Save the ribbed tester collar and O-ring for later use.
2. Pull the old electrode module away from the Testr.
3. Align the four tabs on the new module so that they match the four slots on the Testr (see picture B).
4. Gently push the module onto the slots to sit it in position. Push the smaller O-ring fully onto the new electrode module. Push the collar over the module and thread it into place by firmly twisting clockwise.

Note: It is necessary that you recalibrate your Testr prior to measurement after an electrode replacement.

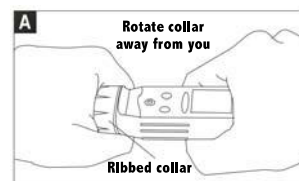


Figure 7: Removal of collar from tester

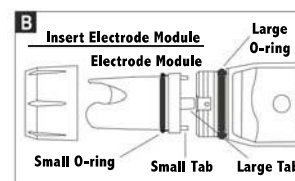


Figure 8: Example of electrode module fitting alignment

Applications

Water quality testing • pools • spas • aquariums • aquaculture • hydroponics • ecology studies • water and wastewater treatment • boilers • steam generators • car washes • sanitation plants • labs • food sectors and more!

Warranty

The waterproof Testrs are warranted to be free from manufacturing defects for 1 year and electrode module for 6 months, unless otherwise specified. If repair, adjustment or replacement is necessary and has not been the result of abuse or misuse within the time period specified, please contact your local distributor for assistance.

Return of Items

Authorization must be obtained from your distributor before returning items for any reason. When applying for authorization, please include information regarding the reason the item(s) are to be returned.

Note: We reserve the right to make improvements in design, construction and appearance of products without notice. Prices are subject to change without notice.

Accessories

Item	Eutech Instruments Order Code	Oakton Instruments Order Code
pHTestr 10,20,30 replacement sensor	PHSENSOR03DJ	35624-38
pHSpear replacement sensor	PHSENSOR04	35634-50
Carrying Pouch pH Testr 10, 20, 30	ECPOUCH01	35624-45

Tester Specifications

Large Screen Testrs	pHTestr10	pHTestr20	pHTestr30	pHTestr 10BNC	pHSpear
pH Range	-1.0 to 15.0 pH	-1.00 to 15.00 pH			
Resolution	0.1 pH	0.01 pH			
Relative Accuracy	0.1 pH	0.01 pH			
Calibration Points	Up to 3 points	Up to 3 points			
Buffer Set Standard Selection	USA - 4.0/7.0/10.0 NIST - 4.0/6.9/9.2	USA - 4.01/7.00/10.01 NIST - 4.01/6.86/9.18			
Calibration Window (USA Buffer Set Standard)	+/-1.0 pH (pH 4.0 & pH 10.0), +/-1.5 pH (pH 7.0)	+/-1.00 pH (pH 4.01 & pH 10.01), +/-1.50 pH (pH 7.00)			
Calibration Window (NIST Buffer Set Standard)	+/-1.0 pH (pH 4.0 & pH 9.2), +/-1.2 pH (pH 6.9)	+/-1.00 pH (pH 4.01 & pH 9.18), +/-1.25 pH (pH 6.86)			
Temperature	No Display	0-50.0°C or 32.0-122.0°F			
Temperature Compensation	ATC			MTC	
Temperature Resolution	No	0.1 °C / °F			
Temperature Accuracy	No	0.5 °C / 0.9 °F			
Temperature Calibration Window	No	+/- (5°C /9 °F) from default value			
Auto Off	After 8.5 minutes from last key press				
User reset	Yes				
Non Volatile Memory Backup	Yes				
LCD Display	Dual				
Power Requirement	4 x 1.5V "A 76" micro Alkaline Batteries				
Battery life	More than 500 hrs				
Operating Temperature	0 – 50 °C				
Tester Dimensions	6.5 "L x 1.5"dia. (165 x 38 mm)				9.75 "L x 1.5"dia. (247 x 38 mm)
Weight	3.25 oz (90 gm)				
Penetrating electrode total length	Not applicable				91 mm
Shaft length	Not applicable				31 mm
Penetrating electrode upper diameter	Not applicable				12 mm
Shaft diameter	Not applicable				7 mm



Quick Reference Guide

INTRO

This “Quick Reference Guide” will provide you with abbreviated instructions for all functions of the Vantage Pro2 console. For more detailed instructions, see *Vantage Pro2 Console Manual*.

Pages with:

CLEAR headings provide general instructions and information about the console.

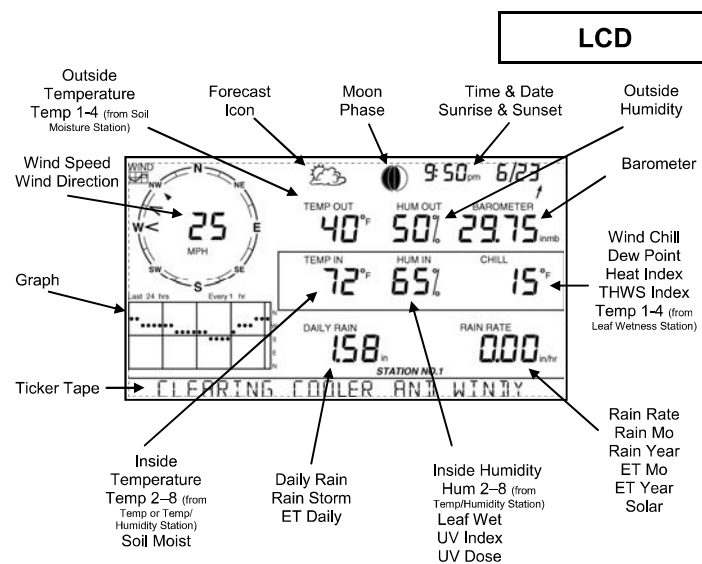
BLACK headings provide instructions for using each key. They are presented in alphabetical order.

Whenever you see “Press 2ND & ANOTHER KEY” in this booklet, this means to press and release 2ND and then immediately press the other key.

REMEMBER: Press and hold DONE at any time to return to the current weather screen. See DONE.

For instructions about:

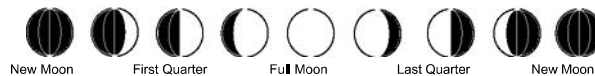
- LEAF WETNESS, see “HUM.”
- SOIL MOISTURE, see “TEMP.”



ICONS

Forecast Icons. See "FORECAST."

Moon Phase. The icons shown below are for the Northern Hemisphere. For the Southern Hemisphere, the orientation is reversed.



Alarm Bell. Appears when you are setting an alarm. Blinks on and off when an alarm is triggered.



Graph Icon. Appears next to a weather variable when you press that variable's key. On most screens, indicates that that variable is being shown on the graph. On the alarm screen, indicates that you are setting an alarm for that variable.



Second Function. Appears when you press **2ND**. Used to select the variable or function printed in white above each key.



Umbrella. Appears when it is currently raining.

TICKER TAPE

Press the appropriate key(s) to view these messages:

- Forecast (within 48 hours) FORECAST
- (10 Min Avg Wind Speed WIND (Wind Speed)
- Last 15 Min of Rain RAIN YR (Rain Rate)
- Last 24 Hrs of Rain RAIN DAY (Daily Rain)
- Heat Index Warning 2ND & HEAT
- If >=90°F (32°C).
- Wind Chill Warning 2ND & CHILL
- If <=0°F (−18°C) and 10-minute average wind speed >=10 mph (16 km/h).

For wireless stations:

- X flashing in the right corner means you are receiving data packets.
- L means the signal has been lost.
- R means the console is attempting to reacquire the transmitter.

SETUP

To enter setup mode: Press and hold **DONE** and then press **(-)**. Press **DONE** to advance or **BAR** to step back through the setup messages:

1. RECEIVING FROM. Displays available transmitting stations.
2. ON/OFF. To set reception for one of the available transmitting stations.
3. RETRANSMIT ON/OFF. To retransmit to another wireless console.
4. Press **(+)** or **(-)** to set the ON (to receive from that station) or OFF.
5. Press **GRAPH** to change station type: ISS, TEMP, HUM, TEMP/HUM, WIND, RAIN, LEAF, SOIL, LEAF/SOIL.
6. Press **(<)** or **(>)** to view the other station IDs.
7. Repeat steps 4-6 to set multiple stations.

To retransmit data to another wireless console:

1. To enter the setup screen, press and hold **DONE** and then press **(-)**.
2. Press **DONE** twice to advance to the RETRANSMIT message in Setup Mode.
3. Press **(+)** or **(-)** to set the retransmit capability ON or OFF.
4. Press **(<)** or **(>)** to advance to the next free station ID.
5. Press and hold **DONE** to return to the current weather screen.

SETUP

To continue through the setup mode:

1. ENTER TIME. To change the time and date. See "TIME."
2. ENTER LATITUDE. Press (+) or (-) to change the flashing digit. Press (<) or (>) to move between fields. Press **2ND** & **UNITS** to change from north to south.
3. ENTER LONGITUDE. Press (+) or (-) to change the flashing digit. Press (<) or (>) to move between fields. Press **2ND** & **UNITS** to change from west to east.
4. TIME ZONE. Press (+) or (-) to view time zones. Press **2ND** to enter GMT offset instead of time zone. Press (+) or (-) to change GMT offset.
5. DAYLIGHT SAVINGS AUTO/MANUAL. Press (+) or (-). To change the setting.
6. DAYLIGHT SAVINGS OFF/ON. If daylight savings setting = AUTO, displays the current status. If daylight savings setting = MANUAL, press (+) or (-) to change the current status.
7. ENTER ELEVATION. To correct barometric pressure. See "BAR."
8. WIND CUP SIZE SMALL/LARGE. Press (+) or (-) to change the setting.
9. RAIN COLLECTOR .01 IN/.2 MM/.1 MM. Press (+) or (-) to change the setting.
10. RAIN SEASON BEGINS. Press (+) or (-) to change the month.

To exit the setup mode: Press and hold **DONE**.

DIAGNOSTICS



The diagnostic screen is used by our tech support staff to help diagnose problems. If you experiencing difficulties call us at **(510) 732-7814**, Monday through Friday, 7:00 a.m. to 5:30 p.m., Pacific Time.

To check reception and/or change antenna gain:



1. To enter the diagnostic screen, press and hold **TEMP** and then press **HUM**. You will see console battery voltage in the ticker tape.
2. Look for the number with the % sign in the middle of the top row. A number $\geq 70\%$ is good or excellent. If the number you see is $< 70\%$, try changing the gain or relocating the console. Sometimes moving the console just a few feet can make a big difference.
3. Press **2ND** & **CHILL** to toggle between diagnostic screen displays.
4. To exit the diagnostic screen, press **DONE**.

2ND

Press  to select the second key function (printed in white type above each key).

The  icon will appear in upper right corner of screen, below the time and date. After you press another key, the icon will disappear. If you wish to select another second key function, you must press  again.

The icon will also time out and disappear from the screen if you do not press another key within a few seconds.

Whenever you see "Press  &  and then immediately press the other key.

ALARM

To set an alarm: See "SET." (NOTE: Not all alarms are available for all weather variables. See *Vantage Pro2 Console Manual* for details.)

When an alarm is triggered, you will hear an audible alarm:

- Until conditions change (i.e., they rise above or fall below the alarm thresholds you have set) or you clear the alarm, if the console is being run on AC power.
- For two minutes, if the console is being run on battery power.
- For one minute, if you have set a time alarm.

And you will see visible alarms:

- The alarm bell icon will blink on and off.
- A message will appear in the ticker tape.

To silence an alarm: Press **DONE**.

To clear all alarm settings: Press **ALARM** to enter the alarm screen. Press and hold **ALARM** until dashes appear in all the fields. Press **DONE** to exit the alarm screen.

To clear individual alarm settings: See "CLEAR."

BAR

Press **BAR** to select:






- Barometric Pressure (0.00 in, 0.0 mm, 0.0 hPa, 0.0 mb)

Press **2ND** & **UNITS** to change unit of measure.

To correct for elevation change:

1. Press and hold **DONE** and then press **(-)** to enter the setup screen.
2. Press **DONE** nine times or until you see ENTER ELEVATION.
3. Press **2ND** & **UNITS** to change from feet to meters, if desired.
4. Press **(+)** or **(-)** to change the flashing digit. Press **(<)** or to move between fields.
5. Press and hold **DONE** to return to the current weather screen.

Barometric Trend Arrow shows change over the last three hours:

-  Increase of 0.06" Hg (2.0 hPa, 1.5 mm Hg) or more.
-  Increase of 0.02" Hg (0.7 hPa, 0.5 mm Hg) or more.
-  Change of less than 0.02" Hg (0.7 hPa, 0.5 mm Hg).
-  Decrease of 0.02" Hg (0.7 hPa, 0.5 mm Hg) or more.
-  Decrease of 0.06" Hg (2.0 hPa, 1.5 mm Hg) or more.

CHILL

Press **2ND** & **CHILL** to display:

- Wind Chill (°F, °C)

Press **2ND** & **UNITS** to change unit of measure.

All temperature-related readings (inside and outside temperature, wind chill, heat index, and dew point) will read in the same unit of measure. Changing one from °F to °C (or vice versa) changes all others.

On the ticker tape:

WIND CHILL WARNING . . . will appear on the ticker tape when you are displaying wind chill if the reading is <0°F (–18°C) and the 10-minute average wind speed is >=10 mph (16 km/h).

CLEAR

To clear a daily, monthly, or yearly amount:

1. Select the variable you wish to clear.
2. Press **2ND** then **CLEAR**, holding **CLEAR** down until the digits stop flashing and zeroes appear in the field.

To clear an alarm setting:

1. Press **ALARM** to enter the alarm screen.
2. Select the alarm setting (see "ALARM" for detailed instructions).
3. Press **2ND**, then **CLEAR**, holding **CLEAR** down until the digits stop flashing and dashes appear in the fields.
4. Press **DONE** to return to the current weather screen.

To clear highs & lows:

Follow the directions above for clearing alarms, except press **HI/LOW** to enter the high/low screen.

To clear ALL (including highs and lows, alarm settings, and daily, monthly, and yearly amounts):

1. Press **WIND**, then **2ND**, then **CLEAR**, holding **CLEAR** down for the entire 6-second countdown until you see CLEARING NOW in the ticker tape.

DEW

Press **2ND** & **DEW** to display:

- Dew Point (°F, °C)

Press **2ND** & **UNITS** to change unit of measure.

All temperature-related readings (inside and outside temperature, wind chill, heat index, and dew point) will read in the same unit of measure. Changing one from °F to °C (or vice versa) changes all others.

A dark gray rectangular button with the word "DONE" in white capital letters.

Press DONE to:

- Accept an alarm setting.
- Exit the alarm screen.
- Silence an alarm.
- Exit the graph screen.
- Exit the high/low screen.
- Go to the next screen in the Setup Mode.

Press and hold DONE and then press (-) to:

- Enter the Setup Mode.

Press and hold DONE to:

- Exit the Setup Mode.

ET

If you have a solar radiation sensor, press 2ND & ET to toggle between:

- ET Day (0.00 in, 0.0 mm)
- ET Month (0.00 in, 0.0 mm)
- ET Year (0.00 in, 0.0 mm)

Press 2ND & UNITS to change unit of measure.

All rain and ET readings will read in the same unit of measure. Changing one from 0.00 inches to 0.0 mm (or vice versa) changes all others.

Update interval:

ET is updated once an hour, on the hour.

FORECAST**Update Interval:**

The forecast is updated once an hour, on the hour.

Forecast Icons:

The forecast icons predict the weather within the next twelve hours.



Mostly
Clear



Partly
Cloudy



Mostly
Cloudy



Rain



Snow

If rain or snow is possible (but less certain than "likely"), you will see the partly cloudy icon along with the rain or snow icon.

Ticker Tape:

Press **FORECAST** to view a detailed forecast in ticker tape. The ticker tape messages predict the weather up to 48 hours ahead.

GRAPH

To enter the graph screen: Press a variable and then press **GRAPH**. You will see the graph and the min & max readings for the selected weather variable. The reading in the weather variable field corresponds to the flashing dot on the graph. To view another weather variable, press the key(s) for that variable.

To view a selected data point: Press **(<)** or **(>)** to move right or left on the graph. The selected data point will flash, and the reading in the weather variable field will change. The time and/or date will also change as you move back and forward on the graph.

To graph highs & lows: Press **(+)** or **(-)** to change the graph to the highs and lows for the last 24 days, months, or years. Press **HI/LOW** to switch between highs and lows. The time and date will change as you move back and forward in time. (NOTE: Not all highs and lows are available for all weather variables. See *Vantage Pro2 Console Manual* for details.)

To exit the graph screen: Press **DONE**.

HEAT

Press **2ND** & **HEAT** to toggle between:

- Heat Index (°F, °C)
- THSW (Temp-Hum-Wind-Sun) Index (°F, °C) if you have solar radiation sensor.

Press **2ND** & **UNITS** to change unit of measure.

All temperature-related readings (inside and outside temperature, wind chill, heat index, and dew point) will read in the same unit of measure. Changing one from °F to °C (or vice versa) changes all others.

On the ticker tape:

HEAT INDEX WARNING . . . will appear on the ticker tape when you are displaying heat index if the reading is $\geq 90^{\circ}\text{F}$ (32°C).

HI/LOW

To enter the high/low screen: Press **HI/LOW**. You will see the time & date of the DAY HIGHS for the currently selected weather variable, along with a graph showing the highs for the last 24 hours or days.

To view a different weather variable, press the key(s) for that variable.

To scroll between highs & lows: Press **HI/LOW** or **(+)** or **(-)** to scroll between:

- Day Highs • Day Lows
- Month Highs • Month Lows
- Year Highs • Year Lows

The time and date will change as you move between the various highs and lows. (NOTE: Not all highs and lows are available for all weather variables. See *Vantage Pro2 Console Manual* for details.)

To go back or forward in time: Press **(<)** or . The time and date will change and the corresponding dot on the graph will flash.

To exit the high/low screen: Press **DONE**.

To clear highs & lows: See "CLEAR."

HUM

Press **HUM** to toggle between:

- Outside Humidity (%)
- Inside Humidity (%)
- Hum 2–8 (%) if you have a Temperature/Humidity Station.
- Leaf Wetness & Outside Temperature (0°F, 0.0°F, 0°C, 0.0°C) if you have a Leaf Wetness Station. Continue to press **HUM** to display each leaf wetness/temperature pair. Maximum is two pairs.

LAMPS

Press **2ND** & **LAMPS** to toggle between:

- Backlight on.
- Backlight off.

If the console is running on AC power:

- The backlight will remain on until you turn it off.

If the console is running on battery power,

- The backlight will remain on as long as you continue pressing various keys or a ticker tape message is scrolling across the screen. It will automatically turn off if you do not press a key within ten seconds.
- The backlight will not come on when battery power is low.

RAIN DAY

Press **RAIN DAY** to toggle between:

- Rain Day (0.00 in, 0.0 mm)
- Rain Storm (0.00 in, 0.0 mm).

Press **2ND** & **UNITS** to change unit of measure.

All rain and ET readings will read in the same unit of measure. Changing one from 0.00 inches to 0.0 mm (or vice versa) changes all others.

To view the last 24 rain storms:

1. Select Rain Storm, then press **GRAPH** to enter the graph screen.
2. Press **(<)** or **(>)** to move backward or forward in time.
3. Press **DONE** to exit the graph screen.

On the ticker tape:

LAST 24 HRS OF RAIN . . . will appear on the ticker tape if it has rained within the last 24 hours and you are currently displaying rain rate.

STORM STARTED ON . . . will appear when you are displaying rain storm.

RAIN YR

Press **RAIN YR** to toggle between:

- Rain Month (0.00 in, 0.0 mm)
- Rain Year (0.00 in, 0.0 mm)
- Rain Rate (0.00 in, 0.0 mm)

Press **2ND** & **UNITS** to change unit of measure.

All rain and ET readings will read in the same unit of measure. Changing one from 0.00 inches to 0.0 mm (or vice versa) changes all others.

When it is currently raining:




will appear between the rain day and rain year fields.

On the ticker tape:

LAST 15 MIN OF RAIN . . . will appear in the ticker tape when you are displaying rain rate.

SET

To set an alarm:

1. Press **ALARM** to enter the alarm screen. The  icon will appear on the screen. In each field, you will either see the alarm setting or, if no alarm has been set, a series of dashes.
2. Press **2ND** & **TIME** or a weather variable key, or use **(+)**, **(-)**, **(<)**, or **(>)** to move between weather variables. Except for the time alarm, the graph icon displays next to the variable you have selected.
3. Press **HI/LOW** to switch between high and low alarms. (Note: Not all alarms are available for all weather variables. See *Vantage Pro2 Console Manual* for details.)
4. Press **2ND** & **SET** to enter or change an alarm setting. Use **(+)** or **(-)** to change the digit within a field. Use **(<)** or **(>)** to move to the next field.
5. Press **DONE** to accept the alarm setting. Repeat steps 2–4 to set another alarm, or press **DONE** again to exit the alarm screen.

The **SET key is also used** to enter selected daily, monthly, and yearly totals and to calibrate selected readings. (See *Console Manual*.)

SOLAR

If you have a solar radiation sensor, press  &  to display:

- Solar Radiation (W/m^2)

TEMP

Press **TEMP** to toggle between:

- Outside Temperature (0°F, 0.0°F, 0°C, 0.0°C)
- Inside Temperature (0°F, 0.0°F, 0°C, 0.0°C)
- Temp 2–8 (0°F, 0.0°F, 0°C, 0.0°C) if you have one or more Temperature and/or Temperature/Humidity Stations.
- Soil Moisture (centibars) & Soil Temperature (0°F, 0.0°F, 0°C, 0.0°C) if you have a Soil Moisture Station. Continue to press **TEMP** to display each soil moisture/temperature pair. Maximum is four pairs.

Press **2ND** & **UNITS** to change unit of measure.

All temperature-related readings (inside and outside temperature, wind chill, heat index, and dew point) will read in the same unit of measure. Changing one from °F to °C (or vice versa) changes all others.

For temperature from Leaf Wetness Station, see "HUM."

TIME

Press **2ND** & **TIME** to toggle between:

- Current Time & Date
- Time of Sunrise & Sunset

To set the time and date:

1. Press and hold **DONE** and then press the down arrow (**↓**) to enter the Setup Mode.
2. Press **DONE** repeatedly until you see ENTER TIME in the ticker tape.
3. Press (**+**) or (**−**) to change the flashing digit. Press (**<**) or (**>**) to move between digits.
4. Press **2ND** & **UNITS** to change from 12- to 24-hour clock or from month/day to day/month, if desired.
5. Press and hold **DONE** to return to the current weather screen.

To correct the time of sunrise and sunset:

Enter latitude, longitude, and time zone in setup screen. See "SETUP."

UNITS

Press **2ND** & **UNITS** to change the unit of measure for a selected variable:

- All temperature-related readings (inside and outside temperature, wind chill, heat index, and dew point) will read in the same unit of measure. Changing one from °F to °C (or vice versa) changes all the others.
- All rain and ET readings will read in the same unit of measure (0.00 inches or 0.0 mm).

In the setup screen, press **2ND** & **UNITS** to:

- Change from 12- to 24-hour clock and from month/day to day/month.
- Change latitude from north to south.
- Change longitude from west to east.
- Change elevation from feet to meters.
- Change wind cup size from small to large.
- Change unit of measure for rain collector.

UV

If you have a UV sensor, press  and  to toggle between:

- UV Index
- UV Dose (meds)

WIND

Press **WIND** to toggle between:

- Wind Speed (0 mph, 0.0 m/s, 0 km/h, 0 knots)
- Wind Direction (degrees)

Press **2ND** & **UNITS** to change unit of measure.

On the compass rose:



Current wind direction



Dominant wind direction for a ten-minute period within the last hour. If dominant wind direction remained constant over the last hour, only one arrow will be shown. If dominant wind direction varied, up to six arrows (representing six ten-minute periods) may be shown.



Current wind direction is the same as one of the dominant wind directions.

On the ticker tape:

10 MIN AVG WIND SPEED . . . will appear on the ticker tape when you are displaying wind speed.



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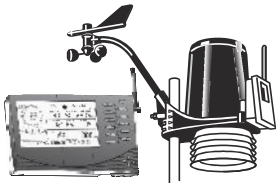
Part Number: 07395.235

Rev B (1/26/2011)

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Wireless Vantage Pro2™ &
Vantage Pro2™ Plus Stations
(Including Fan-Aspirated Models)



6152 6162
6153 6163

VANTAGE PRO2™

Vantage Pro2™ (6152, 6153) and Vantage Pro2™ Plus (6162, 6163) Wireless Weather Stations include two components: the Integrated Sensor Suite (ISS) which houses and manages the external sensor array, and the console which provides the user interface, data display, and calculations. The ISS and Vantage Pro2 console communicate via an FCC-certified, license-free, spread-spectrum frequency-hopping (FHSS) transmitter and receiver. User-selectable transmitter ID codes allow up to eight stations to coexist in the same geographic area. The frequency hopping spread spectrum technology provides greater communication strength over longer distances and areas of weaker reception. The Wireless Vantage Pro2™ Plus weather station includes two additional sensors that are optional on the Vantage Pro2: the UV sensor and the solar radiation sensor. The console may be powered by batteries or by the included AC-power adapter. The wireless ISS is solar powered with a battery backup. Use WeatherLink™ for Vantage Pro and Vantage Pro2 to let your weather station interface with a computer, to log weather data, and to upload weather information to the internet.

The 6152 and 6162 rely on passive shielding to reduce solar-radiation induced temperature errors in the outside temperature sensor readings. The Fan-aspirated 6153 and 6163 combine passive shielding with a solar-powered fan that draws outside air in over the temperature and humidity sensors, providing a much more accurate temperature reading than that available using passive shielding alone.

Integrated Sensor Suite (ISS)

- Operating Temperature -40° to +150°F (-40° to +65°C)
Non-operating Temperature -40° to +158°F (-40° to +70°C)
Current Draw (ISS SIM only) 0.14 mA (average), 30 mA (peak) at 4 to 6 VDC
Solar Power Panel 0.5 Watts (ISS SIM), plus 0.75 Watts (Fan-Aspirated)
Battery (ISS SIM /Fan-Aspirated) CR-123 3-Volt Lithium cell / 2 - 1.2 Volt NiCad C-cells
Battery Life (3-Volt Lithium cell) 8 months without sunlight - greater than 2 years depending on solar charging
Battery Life (NiCad C-cells) 1 year
Fan Aspiration Rate (Fan-Aspirated Only) 190 feet/min. (0.9 m/s) (full sun), 80 feet/min. (0.4 m/s) (battery only) (intake flow rate) 500 feet/min. (2.5 m/s) (full sun), 280 feet/min. (1.4 m/s) (battery only) (sensor chamber flow rate)
Connectors, Sensor Modular RJ-11
Cable Type 4-conductor, 26 AWG
Cable Length, Anemometer 40' (12 m) (included) 540' (165 m) (maximum recommended)
Wind Speed Sensor Wind cups with magnetic switch
Wind Direction Sensor Wind vane with potentiometer
Rain Collector Type Tipping bucket, 0.01" per tip (0.2 mm with metric rain adapter), 33.2 in² (214 cm²) collection area
Temperature Sensor Type PN Junction Silicon Diode
Relative Humidity Sensor Type Film capacitor element
Housing Material UV-resistant ABS, ASA plastic
ISS Dimensions:

Table with 3 columns: Product #, (Length x Width x Height), and Package Weight. Rows include models 6152, 6162, 6153, and 6163 with their respective dimensions and weights.

2

Vantage Pro2™

Console

Console Operating Temperature	.....+32° to +140°F (0° to +60°C)
Non-Operating (Storage) Temperature	.....+14° to +158°F (-10° to +70°C)
Current Draw	.....0.9 mA average, 30 mA peak, (add 120 mA for display lamps, add 0.125 mA for each optional wireless transmitter received by the console) at 4 - 6 VDC
AC Power Adapter	.....5 VDC, 300 mA, regulated
Batteries	.....3 C-cells
Battery Life	.....up to 9 months
Connectors	.....Modular RJ-11
Housing Material	.....UV-resistant ABS plastic
Console Display Type	.....LCD Transflective
Display Backlight	.....LEDs
Dimensions (console: length x width x height, display length x height)	
Console with antenna down	.....10.625" x 6.125" x 1.625" (270 mm x 156 mm x 41 mm)
Console with antenna extended up	.....10.625" x 9.625" x 1.625" (270 mm x 245 mm x 41 mm)
Display	.....5.94" x 3.375" (151 mm x 86 mm)
Weight (with batteries)	.....1.88 lbs. (.85 kg)

Data Displayed on Console

Data display categories are listed with General first, then in alphabetical order.

General

Historical Data	.....Includes the past 24 values listed unless otherwise noted; all can be cleared and all totals reset
Daily Data	.....Includes the earliest time of occurrence of highs and lows; period begins/ends at 12:00 am
Monthly Data	.....Period begins/ends at 12:00 am on the first of the month
Yearly Data	.....Period begins/ends at 12:00 am on the first of January unless otherwise noted
Current Display Data	.....Current display data describes the current reading for each weather variable. In most cases, the variable lists the most recently updated reading or calculation. Some current variable displays can be adjusted so there is an offset for the reading
Current Graph Data	.....Current graph data appears in the right-most column in the console graph and represents the latest value within the last period on the graph; totals can be set or reset. Display intervals vary. Examples include: Instant, 15-min., and Hourly Reading; Daily, Monthly, High and Low
Graph Time Interval	.....1 min., 10 min., 15 min., 1 hour, 1 day, 1 month, 1 year (user-selectable, availability depends upon variable selected)
Graph Time Span	.....24 Intervals + Current Interval (see Graph Intervals to determine time span)
Graph Variable Span (Vertical Scale)	.....Automatic (varies depending upon data range); Maximum and Minimum value in range appear in ticker
Alarm Indication	.....Alarms sound for only 2 minutes (time alarm is always 1 minute) if operating on battery power. Alarm message is displayed in ticker as long as threshold is met or exceeded. Alarms can be silenced (but not cleared) by pressing the DONE key.
Transmission Interval	.....Varies with transmitter ID code from 2.25 seconds (#1=shortest), to 3 seconds (#8=longest)
Update Interval	.....Varies with sensor - see individual sensor specs

Barometric Pressure

Resolution and Units	.....0.01" Hg, 0.1 mm Hg, 0.1 hPa/mb (user-selectable)
Range	.....16.00" to 32.50" Hg, 410 to 820 mm Hg, 540 to 1100 hPa/mb
Elevation Range	.....-999' to +15,000' (-600 m to 4570 m) (Note that console screen limits entry of lower elevation to -999' when using feet as elevation unit.)
Uncorrected Reading Accuracy	.....±0.03" Hg (±0.8 mm Hg, ±1.0 hPa/mb) (at room temperature)
Sea-Level Reduction Equation Used	.....United States Method employed prior to use of current "R Factor" method

Equation Source	Smithsonian Meteorological Tables
Equation Accuracy	±0.01" Hg (±0.3 mm Hg, ±0.3 hPa/mb)
Elevation Accuracy Required	±10' (3m) to meet equation accuracy specification
Overall Accuracy	±0.03" Hg (±0.8 mm Hg, ±1.0 hPa/mb)
Trend (change in 3 hours)	Change 0.06" (2 hPa/mb, 1.5 mm Hg) = Rapidly Change 0.02" (.7hPa/mb, .5 mm Hg)= Slowly
Trend Indication	5 position arrow: Rising (rapidly or slowly), Steady, or Falling (rapidly or slowly)
Update Interval	1 minute or when console BAR key is pressed twice
Current Display	Instant
Current Graph Data	Instant, 15-min., and Hourly Reading; Daily, Monthly, High and Low
Historical Graph Data	15-min. and Hourly Reading; Daily, Monthly Highs and Lows
Alarms	High Threshold from Current Trend for Storm Clearing (Rising Trend) Low Threshold from Current Trend for Storm Warning (Falling Trend)
Range for Rising and Falling Trend Alarms	0.01 to 0.25" Hg (0.1 to 6.4 mm Hg, 0.1 to 8.5 hPa/mb)

Clock

Resolution	1 minute
Units	Time: 12 or 24 hour format (user-selectable)
Date	US or International format (user-selectable)
Accuracy	±8 seconds/month
Adjustments	Time: Automatic Daylight Savings Time (for users in North America and Europe that observe it in AUTO mode, MANUAL setting available for all other areas) Date: Automatic Leap Year
Alarms	Once per day at set time when active

Dewpoint (calculated)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-105° to +130°F (-76° to +54°C)
Accuracy	±3°F (±1.5°C) (typical)
Update Interval	10 to 12 seconds
Source	World Meteorological Organization (WMO)
Equation Used	WMO Equation with respect to saturation of moist air over water
Variables Used	Instant Outside Temperature and Instant Outside Relative Humidity
Current Display Data	Instant Calculation
Current Graph Data	Instant Calculation; Daily, Monthly High and Low
Historical Graph Data	Hourly Calculations; Daily, Monthly Highs and Lows
Alarms	High and Low Threshold from Instant Calculation

Evapotranspiration (calculated, requires solar radiation sensor)

Resolution and Units	0.01" or 0.1 mm (user-selectable)
Range	Daily to 32.67" (832.1 mm); Monthly & Yearly to 199.99" (1999.9 mm)
Accuracy	Greater of 0.01" (0.25 mm) or ±5%, Reference: side-by-side comparison against a CIMIS ET weather station
Update Interval	1 hour
Calculation and Source	Modified Penman Equation as implemented by CIMIS (California Irrigation Management Information System) including Net Radiation calculation
Current Display Data	Latest Hourly Total Calculation
Current Graph Data	Latest Hourly Total Calculation, Daily, Monthly, Yearly Total
Historical Graph Data	Hourly, Daily, Monthly, Yearly Totals
Alarm	High Threshold from Latest Daily Total Calculation

Forecast

Variables Used	Barometric Reading & Trend, Wind Speed & Direction, Rainfall, Temperature, Humidity, Latitude & Longitude, Time of Year
Update Interval	1 hour
Display Format	Icons on top center of display; detailed message in ticker at bottom
Variables Predicted	Sky Condition, Precipitation, Temperature Changes, Wind Direction and Speed

Heat Index (calculated)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-40° to +165°F (-40° to +74°C)
Accuracy	±3°F (±1.5°C) (typical)
Update Interval	10 to 12 seconds
Source	United States National Weather Service (NWS)/NOAA
Formulation Used	Steadman (1979) modified by US NWS/NOAA and Davis Instruments to increase range of use
Variables Used	Instant Outside Temperature and Instant Outside Relative Humidity
Current Display Data	Instant Calculation
Current Graph Data	Instant Calculation; Daily, Monthly High
Historical Graph Data	Hourly Calculations; Daily, Monthly Highs
Alarm	High Threshold from Instant Calculation

Humidity

Inside Relative Humidity (sensor located in console)

Resolution and Units	1%
Range	1 to 100% RH
Accuracy	±3% (0 to 90% RH), ±4% (90 to 100% RH)
Update Interval	1 minute
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant; Hourly Reading; Daily, Monthly High and Low
Historical Graph Data	Hourly Readings; Daily, Monthly Highs and Lows
Alarms	High and Low Threshold from Instant Reading

Outside Relative Humidity (sensor located in ISS)

Resolution and Units	1%
Range	1 to 100% RH
Accuracy	±3% (0 to 90% RH), ±4% (90 to 100% RH)
Temperature Coefficient	0.03% per °F (0.05% per °C), reference 68°F (20°C)
Drift	±0.5% per year
Update Interval	50 seconds to 1 minute
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant; Hourly Reading; Daily, Monthly High and Low
Historical Graph Data	Hourly Readings; Daily, Monthly Highs and Lows
Alarms	High and Low Threshold from Instant Reading

Extra Outside Relative Humidity (sensor located inside Temperature/Humidity Station)

Resolution and Units	1%
Range	1 to 100% RH
Accuracy	±3% (0 to 90% RH), ±4% (90 to 100% RH)
Temperature Coefficient	0.03% per °F (0.05% per °C), reference 68°F (20°C)
Drift	±0.5% per year
Update Interval	50 seconds to 1 minute
Current Display Data	Instant Reading (user adjustable)
Alarms	High and Low Threshold from Instant Reading

Leaf Wetness (requires leaf wetness sensor)

Resolution	1
Range.....	0 to 15
Dry/Wet Threshold	User-selectable
Accuracy	±0.5
Update Interval.....	15 to 18 seconds
Current Graph Data	Instant Reading; Daily High and Low; Monthly High
Historical Graph Data	Hourly Readings; Daily Highs and Lows; Monthly Highs
Alarms	High and Low Thresholds from Instant Reading

Moon Phase

Console Resolution.....	1/8 (12.5%) of a lunar cycle, 1/4 (25%) of lighted face on console
WeatherLink Resolution	0.09% of a lunar cycle, 0.18% of lighted face maximum (depends on screen resolution)
Range.....	New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, Waning Crescent
Accuracy	±38 minutes

Rainfall

Resolution and Units.....	0.01" or 0.2 mm (user-selectable) (1 mm at totals ≥ 2000 mm)
Daily/Storm Rainfall Range.....	0 to 99.99" (0 to 999.8 mm)
Monthly/Yearly/Total Rainfall Range.....	0 to 199.99" (0 to 6553 mm)
Rain Rate	0 to 96" (0 to 2438 mm)
Accuracy	For rain rates up to 2"/hr (50 mm/hr): ±4% of total or +0.01" (0.2mm) (0.01" = one tip of the bucket), whichever is greater. For rain rates from 2"/hr (50 mm/hr) to 4"/hr (100 mm/hr): ±4% of total or +0.01" (0.25 mm) (0.01" = one tip of the bucket), whichever is greater
Update Interval	20 to 24 seconds
Storm Determination Method	0.02" (0.5 mm) begins a storm event, 24 hours without further accumulation ends a storm event
Current Display Data	Totals for Past 15-min
Current Graph Data	Totals for Past 15-min, Past 24-hour, Daily, Monthly, Yearly (start date user-selectable) and Storm (with begin date); Umbrella is displayed when 15-minute total exceeds zero
Historical Graph Data	Totals for 15-min, Daily, Monthly, Yearly (start date user-selectable) and Storm (with begin and end dates)
Alarms	High Threshold from Latest Flash Flood (15-min. total, default is 0.50", 12.7 mm), 24-Hour Total, Storm Total,
Range for Rain Alarms	0 to 99.99" (0 to 999.7 mm)

Rain Rate

Resolution and Units.....	0.01" or 0.1 mm (user-selectable) at typical rates (see Fig. 3 and 4)
Range.....	0, 0.04"/hr (1 mm/hr) to 96"/hr (0 to 2438 mm/hr)
Accuracy	±5% for rates less than 5" per hour (127 mm/hr)
Update Interval.....	20 to 24 seconds
Calculation Method.....	Measures time between successive tips of tipping bucket. Elapsed time greater than 15 minutes or only one tip of the rain collector constitutes a rain rate of zero.
Current Display Data	Instant
Current Graph Data	Instant and 1-min. Reading; Hourly, Daily, Monthly and Yearly High
Historical Graph Data	1-min Reading; Hourly, Daily, Monthly and Yearly Highs
Alarm	High Threshold from Instant Reading

Soil Moisture (requires soil moisture Sensor)

Resolution	1 cb
Range	0 to 200 cb
Update Interval	75 to 90 seconds
Current Graph Data	Instant Reading; Daily and Monthly High and Low
Historical Graph Data	Hourly Readings; Daily and Monthly Highs and Lows
Alarms	High and Low Thresholds from Instant Reading

Solar Radiation (requires solar radiation sensor)

Resolution and Units	1 W/m ²
Range	0 to 1800 W/m ²
Accuracy	±5% of full scale (Reference: Eppley PSP at 1000 W/m ²)
Drift	up to ±2% per year
Cosine Response	±3% for angle of incidence from 0° to 75°
Temperature Coefficient	-0.067% per °F (-0.12% per °C); reference temperature = 77°F (25 °C)
Update Interval	50 seconds to 1 minute (5 minutes when dark)
Current Graph Data	Instant Reading and Hourly Average; Daily, Monthly High
Historical Graph Data	Hourly Average, Daily, Monthly Highs
Alarm	High Threshold from Instant Reading

Sunrise and Sunset

Resolution	1 minute
Accuracy	±1 minute
Reference	United States Naval Observatory

Temperature

Inside Temperature (sensor located in console)

Resolution and Units	Current Data: 0.1°F or 1°F or 0.1°C or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C Historical Data and Alarms: 1°F or 1°C (user-selectable)
Range	+32° to +140°F (0° to +60°C)
Sensor Accuracy	±1°F (±0.5°C)
Update Interval	1 minute
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant Reading; Daily and Monthly High and Low
Historical Graph Data	Hourly Readings; Daily and Monthly Highs and Lows
Alarms	High and Low Thresholds from Instant Reading

Outside Temperature (sensor located in ISS)

Resolution and Units	Current Data: 0.1°F or 1°F or 0.1°C or 1°C (user-selectable) nominal (see Fig. 1) °C is converted from °F rounded to the nearest 1°C Historical Data and Alarms: 1°F or 1°C (user-selectable)
Range	-40° to +150°F (-40° to +65°C)
Sensor Accuracy	±1°F (±0.5°C) above 20°F (-7°C), ±2°F (±1°C) under 20°F (-7°C) (see Fig. 2)
Radiation Induced Error (Passive Shield)	+4°F (2°C) at solar noon (insolation = 1040 W/m ² , avg. wind speed ≤ 2 mph (1 m/s)) (reference: RM Young Model 43408 Fan-Aspirated Radiation Shield)
Radiation Induced Error (Fan-Aspirated Shield)	+0.6°F (0.3°C) at solar noon (insolation = 1040 W/m ² , avg. wind speed ≤ 2 mph (1 m/s)) (reference: RM Young Model 43408 Fan-Aspirated Radiation Shield)
Update Interval	10 to 12 seconds
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant Reading; Daily, Monthly, Yearly High and Low
Historical Graph Data	Hourly Readings; Daily, Monthly, Yearly Highs and Lows
Alarms	High and Low Thresholds from Instant Reading

Extra Temperature Sensors or Probes

Resolution and Units	Current Data: 1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C Historical Data and Alarms: 1°F or 1°C (user-selectable)
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Range	-40° to +150°F (-40° to +65°C)
Sensor Accuracy	±1°F (±0.5°C) above 20°F (-7°C), ±2°F (±1°C) under 20°F (-7°C) (see Fig. 2)
Update Interval	10 to 12 seconds (40 to 48 seconds for Leaf Wetness/Temperature and Soil Moisture/Temperature Stations)
Current Display Data	Instant Reading (user-adjustable offset available)
Alarms	High and Low Thresholds from Instant Reading

Temperature Humidity Sun Wind Index (requires solar radiation sensor)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-90° to +165°F (-68° to +74°C)
Accuracy	±4°F (±2°C) (typical)
Update Interval	10 to 12 seconds
Sources and Formulation Used	United States National Weather Service (NWS)/NOAA Steadman (1979) modified by US NWS/NOAA and Davis Instruments to increase range of use and allow for cold weather use
Variables Used	Instant Outside Temperature, Instant Outside Relative Humidity, 10-minute Average Wind Speed, 10-minute Average Solar Radiation
Formulation Description	Uses Heat Index as base temperature, affects of wind and solar radiation are either added or subtracted from this base to give an overall effective temperature
Current Graph Data	Instant and Hourly Calculation; Daily, Monthly High
Historical Graph Data	Hourly Calculation; Daily, Monthly Highs
Alarm	High Threshold from Instant Reading

Ultra Violet (UV) Radiation Dose (requires UV sensor)

Resolution and Units	0.1 MEDs to 19.9 MEDs; 1 MED above 19.9 MEDS
Range	0 to 199 MEDs
Accuracy	±5% of daily total
Drift	up to ±2% per year
Update Interval	50 seconds to 1 minute (5 minutes when dark)
Current Graph Data	Latest Daily Total (user resetable at any time from Current Screen)
Historical Graph Data	Hourly, Daily Totals (user reset from Current Screen does not affect these values)
Alarm	High Threshold from Daily Total

Alarm Range 0 to 19.9 MEDs

Ultra Violet (UV) Radiation Index (requires UV sensor)

Resolution and Units	0.1 Index
Range	0 to 16 Index
Accuracy	±5% of full scale (Reference: Yankee UVB-1 at UV index 10 (Extremely High))
Cosine Response	±4% (0° to 65° incident angle); 9% (65° to 85° incident angle)
Update Interval	50 seconds to 1 minute (5 minutes when dark)
Current Graph Data	Instant Reading and Hourly Average; Daily, Monthly High
Historical Graph Data	Hourly Average, Daily, Monthly Highs
Alarm	High Threshold from Instant Calculation

Wind

Wind Chill (Calculated)	
Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F and rounded to the nearest 1°C
Range	-110° to +135°F (-79° to +57°C)
Accuracy	±2°F (±1°C) (typical)
Update Interval	10 to 12 seconds
Source	United States National Weather Service (NWS)/NOAA
Equation Used	Osczevski (1995) (adopted by US NWS in 2001)
Variables Used	Instant Outside Temperature and 10-min. Avg. Wind Speed
Current Display Data	Instant Calculation

Vantage Pro2™

Current Graph Data	Instant Calculation; Hourly, Daily and Monthly Low
Historical Graph Data	Hourly, Daily and Monthly Lows
Alarm	Low Threshold from Instant Calculation
Wind Direction	
Range.	0 - 360°
Display Resolution	16 points (22.5°) on compass rose, 1° in numeric display
Accuracy	±3°
Update Interval	2.5 to 3 seconds
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant; 10-min. Dominant; Hourly, Daily, Monthly Dominant
Historical Graph Data	Past 6 10-min. Dominants on compass rose only; Hourly, Daily, Monthly Dominants
Wind Speed	
Resolution and Units.	1 mph, 1 km/h, 0.4 m/s, or 1 knot (user-selectable). Measured in mph, other units are converted from mph and rounded to nearest 1 km/hr, 0.1 m/s, or 1 knot.
Range.	2 to 180 mph, 2 to 156 knots, 1 to 80 m/s, 3 to 290 km/h
Update Interval	Instant Reading: 2.5 to 3 seconds, 10-minute Average: 1 minute
Accuracy	±2 mph (2 kts, 3 km/h, 1 m/s) or ±5%, whichever is greater
Maximum Cable Length	540' (165 m)
Current Display Data	Instant
Current Graph Data	Instant; 10-minute and Hourly Average; Hourly High; Daily, Monthly and Yearly High with Direction of High
Historical Graph Data	10-min. and Hourly Averages; Hourly Highs; Daily, Monthly and Yearly Highs with Direction of Highs
Alarms	High Thresholds from Instant Reading and 10-minute Average

Wireless Communications

Transmit/Receive Frequency	US Models: 902-928 MHz FHSS, Overseas Models: 868.0 - 868.6 MHz FHSS
ID Codes Available.	8
Output Power.	902-928 MHz FHSS: FCC-certified low power, less than 8 mW, no license required 868.0 - 868.6 MHz FHSS. CE-certified, less than 8 mW, no license required
Range	
Line of Sight.	up to 1000 feet (300 m)
Through Walls	200 to 400 feet (60 to 120 m)
Sensor Inputs	
RF Filtering.	RC low-pass filter on each signal line

Sensor Charts

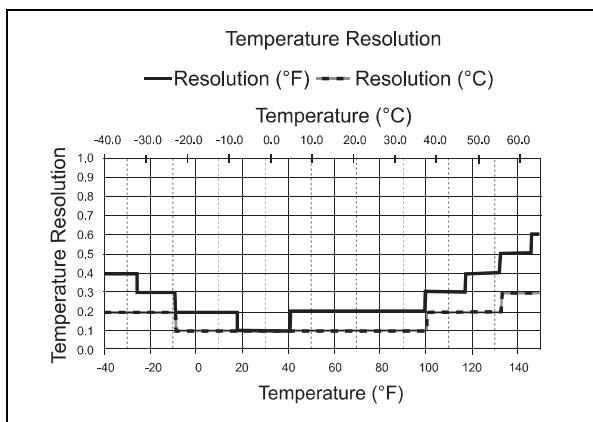


Figure 1. Temperature Resolution

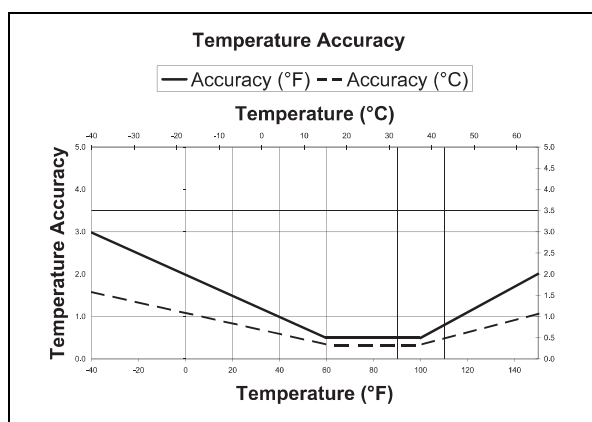


Figure 2. Temperature Accuracy

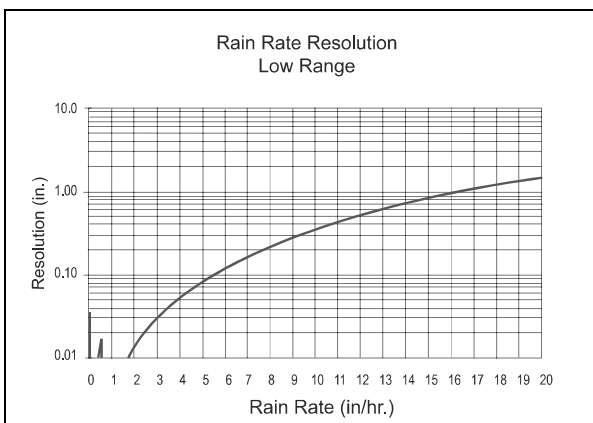


Figure 3. Low Range Rain Rate Resolution

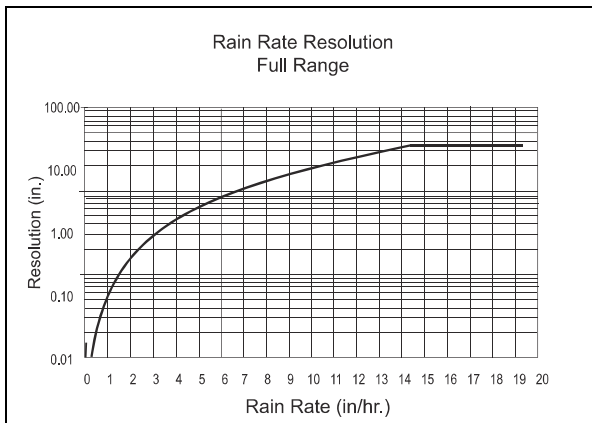


Figure 4. Full Range Rain Rate Resolution

Package Dimensions

Product #	Package Dimensions (Length x Width x Height)	Package Weight	UPC Codes
6152 6152EU 6152UK	17.0" x 11.0" x 13.0" (410 mm x 264 mm x 330 mm)	12.8 lbs. (5.8 kg)	011698 00229 0 011698 00347 1 011698 00348 8
6162 6162EU 6162UK		13.3 lbs. (6.0 kg)	011698 00306 8 011698 00307 5 001698 00308 2
6153 6153EU 6153UK	15.0" x 13.0" x 24.0" (378 mm x 327 mm x 594 mm)	12.8 lbs. (5.8 kg)	011698 00335 8 011698 00336 5 001698 00337 2
6163 6163EU 6163UK		13.3 lbs. (6.0 kg)	011698 00341 9 011698 00342 6 001698 00342 3

Integrated Sensor Suite Installation Manual



For Vantage Pro2™ & Vantage Pro2 Plus™ Weather Stations



Davis Instruments, 3465 Diablo Avenue, Hayward, CA 94545 USA • 510-732-9229 • www.davisnet.com

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FCC Part 15 Class B Registration Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modification not expressly approved in writing by Davis Instruments may void the warranty and void the user's authority to operate this equipment.

FCC ID: IR2DWW6328

IC: 378810-6328

EC EMC Compliance

This product complies with the essential protection requirements of the EC EMC Directive 2004/108/EC; Low Voltage Directive 2006/95/EC; and Eco-Design Directive 2005/32/EC >0.5 watt no-load adapter.

Introduction

The Integrated Sensor Suite (ISS) collects outside weather data and sends the data to a Vantage Pro2 console or Weather Envoy. Wireless and cabled versions of the ISS are available, as well as Standard and Plus versions. The Wireless ISS is solar powered and sends data to the console via a low-power radio. The Cabled ISS sends data and receives power via the console cable.

Note: If you are using a wireless ISS, it can transmit to a Vantage Pro2 console, as well as a Davis Vantage Vue console or Davis Weather Envoy. One ISS can transmit to any number of receivers within its range, so you can add additional consoles to use in different rooms.

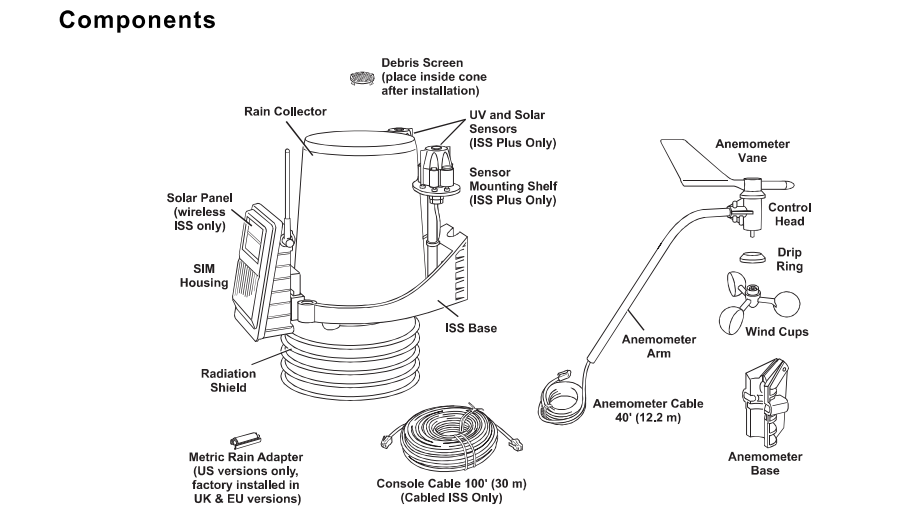
The standard version of the ISS contains a rain collector, temperature sensor, humidity sensor and anemometer. In addition to the standard weather features, the ISS Plus adds a pre-installed solar radiation sensor and an ultra-violet (UV) radiation sensor. Temperature and humidity sensors are mounted in a passive radiation shield to minimize the impact of solar radiation on sensor readings. The anemometer measures wind speed and direction and can be installed adjacent to the ISS or apart from it. See "Locating the ISS and Anemometer" on page 17 for siting guidelines.

On an ISS Plus, the additional solar and UV sensors are mounted next to the rain collector cone. Separate solar and UV sensors are available to upgrade a standard ISS.

The Sensor Interface Module (SIM) contains the "brains" of the ISS and the radio transmitter. The SIM is located on the front of the radiation shield in the SIM box. The SIM collects outside weather data from the ISS sensors and then transmits the data to your Vantage Pro2 console or Weather Envoy.

Included Components and Hardware

The ISS comes with all the components and hardware shown in the following illustrations. If you purchased your ISS as part of a weather station package containing the Vantage Pro2 console, additional components may be included in the package that are not shown here.

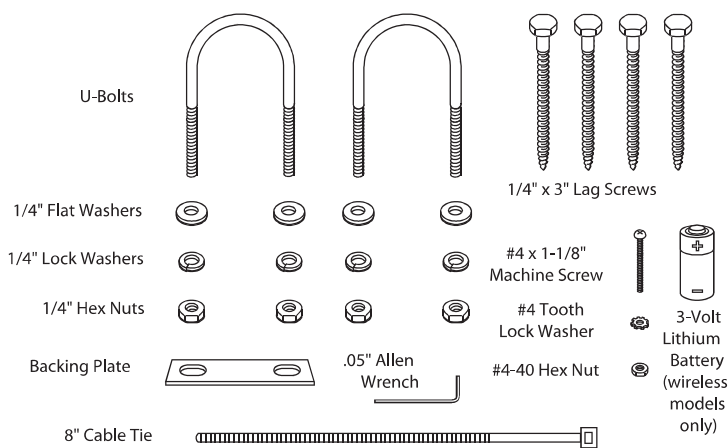


Preparing the ISS for Installation

Note: If the ISS is a Plus model and contains UV and solar sensors, do not touch the small white diffusers on top of the sensors. Oil from skin reduces their sensitivity. If you are concerned that you have touched the diffusers at any time during the installation, clean the UV diffuser using ethyl alcohol with a soft cloth. When cleaning the UV diffuser, DO NOT use rubbing or denatured alcohols because they can affect accuracy of the sensor readings. Ethyl alcohol can be procured through an industrial or laboratory supply store. Clean the solar diffuser with a soft damp cloth.

Hardware

The following hardware is included with the ISS and weather station assembly. Some of the hardware is optional based on how the ISS is assembled and installed.



Note: If any of the hardware components are missing or not included, contact Customer Service toll free at 1-800-678-3669 about receiving replacement hardware or other components.

Tools for Setup

- The following are additional tools required to set up and install the ISS:
- Small Phillips head screwdriver
 - Scissors or wire-cutters
 - Adjustable wrench or 7/16" wrench
 - Compass or local area map
 - Ballpoint pen or paper clip (or other small pointed object)
 - Drill and 3/16" (5 mm) drill bit (if mounting on a vertical surface)

Preparing the ISS for Installation

Please follow the steps in the order they are presented. Each step builds on tasks completed in previous steps.

Note: Using a well-lit work table or work area to prepare the ISS for installation is recommended.

- The steps to prepare the ISS for installation are:
- Assemble the anemometer.
 - Check the factory-installed sensor cable connections to the SIM.
 - Connect the anemometer sensor cable to the SIM.

- Apply power to the ISS and test communication with the console.
- Change the Transmitter ID for wireless communication, if necessary.

Assemble the Anemometer

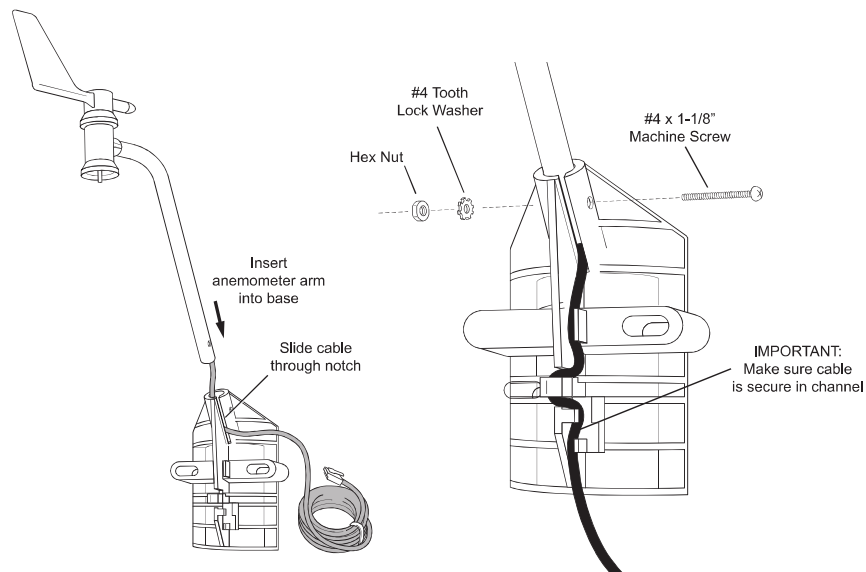
The anemometer measures wind direction and speed. The anemometer arm comes partially assembled with the wind vane attached. The anemometer arm requires assembly before it can be assembled with the rest of the ISS.

Please locate the following parts to prepare the anemometer:

- Anemometer arm (wind vane and cable already attached)
- Anemometer base
- Wind cups
- Drip ring
- Allen wrench (0.05")
- #4 machine screw, #4 tooth-lock washer, #4 hex nut

Attaching Anemometer Arm to Base

1. Insert the anemometer arm into the base, sliding the cable through the notch in the base as shown in illustration.
2. Be sure to line up the small hole in the arm with the holes in the base.
3. Insert the machine screw through the holes in the base and arm.



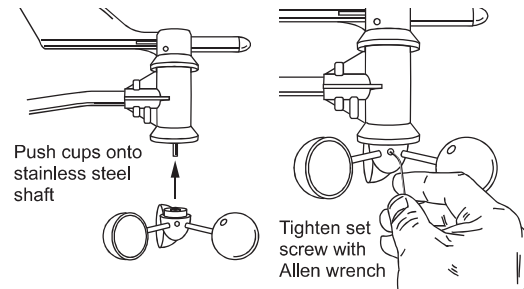
4. Slide the tooth-lock washer and hex nut onto the machine screw. Tighten the hex nut while holding the screw with a Phillips head screwdriver to prevent it from turning.
5. Press the sensor cable firmly and completely into the zig-zagging channel in the base, starting from the arm and progressing downward to the bottom of the base.

Check SIM Sensor Connections

Attaching the Wind Cups

1. Push the wind cups up onto the anemometer's stainless steel shaft.
2. Slide the wind cups up the shaft as far as possible.

Note: **Make sure to push the cups onto the stainless steel shaft as far up the shaft as possible. Failure to do so will cause the anemometer to function improperly.**



Attaching Wind Cups

3. Use the Allen wrench provided to tighten the set screw on the side of the wind cups.
The wind cups should drop slightly when you let go.

Note: Ensure that the set screw is screwed in fully and very tight. Failure to do so will cause the anemometer to function improperly.

4. Spin the wind cups.
If the wind cups spin freely, the anemometer is ready and can be set aside while you prepare the rest of the ISS for installation.

Note: **If the wind cups don't spin freely, take them off and repeat the wind cup installation process.**

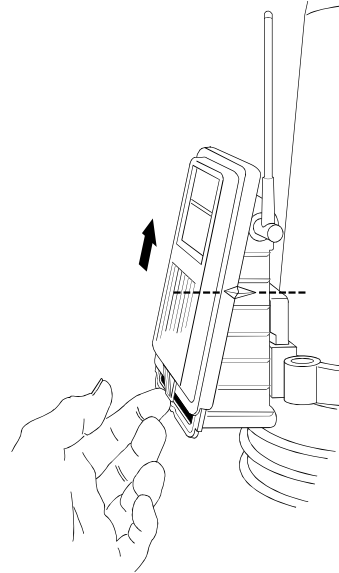
Check SIM Sensor Connections

The SIM is located in the housing on the front of the ISS station. The SIM contains all the connections for the weather sensors of the ISS. Follow the steps below to check the SIM and ensure that all sensors are connected properly.

Open the SIM Box

1. Locate the white box with the solar panel containing the SIM on the front of the ISS unit. The cabled model does not have a solar panel.
2. Locate the white tab at the bottom center of the SIM box cover.
3. Lift the tab away from the box while sliding the cover up. Look on the side of the SIM box. The box cover can be easily removed from the box when the alignment indicator on the cover is lined up with the alignment indicator on the box.
4. Lift the cover off the box, being careful not to stress the solar panel cable when removing the cover.

The SIM and sensor connectors are visible once the SIM cover has been removed.

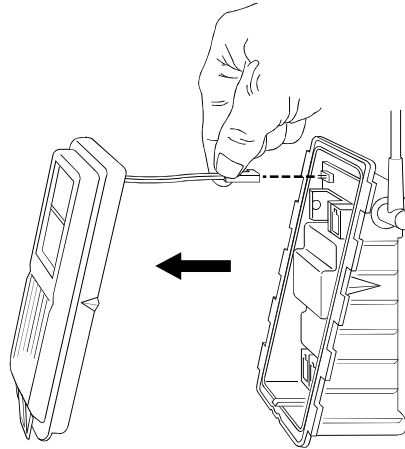


Note: See "SIM Board Display and Contents" on page 29 for information on locating the components and points of interest on the SIM board.

Optional: Disconnect the solar panel connection

The solar panel on the box cover is connected to the SIM by a wire. If the cover cannot be set aside while still connected to the SIM box safely, it should be disconnected from the SIM box. To disconnect the solar power connection:

1. Locate the brown connector for the solar power wire.
2. Pull the connector outward off the brown solar power tab. The solar panel is no longer connected to the SIM.
3. Set the SIM cover aside.

**Check the Factory Installed Sensor Connections**

1. Verify that the rain collector and temperature/humidity sensor cables are plugged into the receptacles labeled RAIN and TEMP/HUM on the SIM.
2. If the station includes UV and/or solar radiation sensors, verify that the sensor cables are plugged into the receptacles labeled UV and SUN on the SIM.

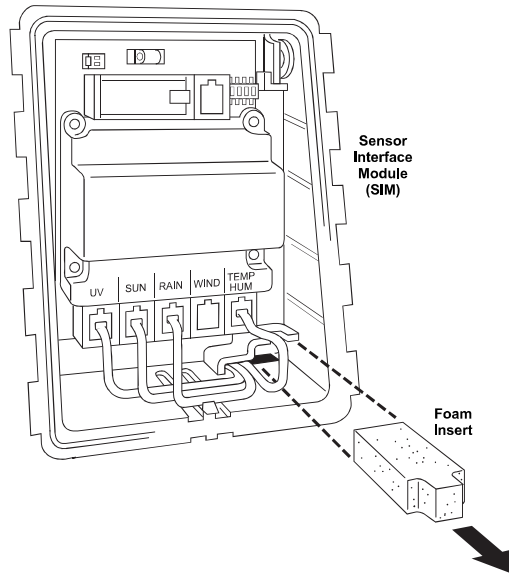
Check SIM Sensor Connections

Connect the Anemometer Cable to the SIM

1. Unwind the coil of cable enough to work with the anemometer.

Note: Do not unwind the entire coil of anemometer cable at this time.

2. Pull the foam insert out of cable access port in between the cables and set the foam insert aside.
3. Insert the anemometer cable end into the cable access port from beneath the SIM box. Slide the cable through the cable access port with the connector lever down.
4. Firmly insert the end of the anemometer cable into the connector labeled WIND. The lever clicks into place.
5. Make sure that the cables lie flat on the bottom of the cable access port.
6. Firmly insert the foam in between the cables and at the top of the cable access port, taking care to ensure that the foam seals the access port entirely, leaving no holes or gaps large enough for weather or insects.



Note: Only Plus models have UV and solar cables already attached.

Note: If you are assembling a cabled station, wait to reinsert the foam until cable assembly is complete. See “Cabled ISS Assembly” on page 8.

Once the sensor connections have been checked and the anemometer cable has been inserted, a connection between the ISS and the Vantage Pro2 console must be made.

7. Follow the instructions that best apply to your ISS and console:
 - See “Cabled ISS Assembly” on page 8 for assembling Vantage Pro2 weather stations that contain a cabled connection between the ISS and the console.
 - See “Wireless ISS Assembly” on page 11 for assembling Vantage Pro2 weather stations that use a wireless connection to transmit and receive data.

Cabled ISS Assembly

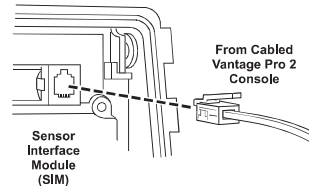
The Cabled ISS system contains a cable for connecting the ISS to a Vantage Pro2 cabled console. Once the anemometer has been installed and the sensors have been checked, a cabled connection between the ISS and the console can be established. Follow the steps below for powering the ISS and connecting to the console.

Applying Power

The 100' (30 m) console cable provides power to the ISS and is used to send data from the ISS to the console. The console cable can be extended up to 1000' (305 m) in length with extension cables purchased from Davis Instruments.

1. Locate the 100' console cable included with your system.
2. Pull the foam insert out of cable access port, if it has been reinserted, and set the foam aside.
3. Insert the console connector cable end into the cable access port from beneath the SIM box. Slide the cable through the cable access port with the connector tab down.
4. On the SIM, firmly insert one end of the 4-conductor cable into the modular connector located apart from the sensor connectors next to the battery insert. This connector is labeled COMM. If you haven't powered up the console yet, refer to the installation instructions in the *Vantage Pro2 Console Manual* and apply power to the console.
5. On the back of your console, insert the other end of the console cable into the modular receptacle labeled "ISS."
6. Firmly insert the foam in between the cables and at the top of the cable access port, taking care to ensure that the foam seals the access port entirely, leaving no holes or gaps for weather or insects. See the graphic on page 6 for more information on inserting the foam insert.

Plugging the console cable into the console powers the ISS and establishes communication between the ISS and the console. The ISS should immediately begin collecting weather data and start sending the data to the console.



Verifying Communication with the Console

Use these steps to verify reception of ISS data at the Cabled Vantage Pro2 console and to test the operation of the ISS sensors.

1. If the console is in Setup Mode, press and hold DONE until the Current Weather screen displays.
Sensor readings from the ISS should display on the screen.
2. Near the center of the screen, look for the outside temperature.
3. Spin the wind cups to check wind speed, pressing WIND if necessary to alternate between speed and direction in the compass rose.
4. Turn the wind vane and allow five seconds for the wind direction display to stabilize before moving it again.
Approximately one minute after power-up the outside relative humidity reading should be displayed on the console.

-
5. If the ISS contains a UV sensor and/or solar sensor, press 2ND and then press RAIN YR for current ultraviolet readings or press 2ND then press RAIN DAY for solar radiation readings.
The UV reading displays in the center of the console. The solar reading displays in the bottom right corner of the console display. UV and solar readings should be zero or close to zero if the ISS is inside. Zero is a valid reading. Dashes(--) are displayed if no data comes from the sensors.
6. Current weather data displayed on the console confirms communication.
Once the ISS has been powered and the console has successfully received accurate readings from all the sensors, prepare the ISS for installation. Continue on to "Preparing the ISS for Installation" on page 15 for more information.
If the communication problems still exist between the cabled ISS and the console, see "Troubleshooting Cabled ISS Communication" below.
To ease the installation process of ISS at a location, disconnect the console cable from the SIM. Remove the foam and slide the cable out through access port. Once a location for both the ISS and the console has been arranged, reinsert the cable through the access port, into the console connector, and reinsert the foam.

Troubleshooting Cabled ISS Communication

If the console is not receiving sensor readings from the ISS, please try the following troubleshooting procedures.

- Check the console to make sure it is being powered with the AC adapter supplied in the Vantage Pro2 packaged box or three C batteries.

Note: The supplied adapter is a five-volt positive center AC to DC adapter. Other adapters may not work if the voltage or adapter type is different.

- Make sure the cable is firmly plugged into the ISS jack on the console.
- Make sure that the cable is firmly plugged into the correct jack on the SIM.
- Verify that all sensor cables are firmly plugged in.
- An LED indicator light on the SIM flashes each time the ISS transmits, which is about once every 2.5 seconds. If the LED remains dark, there is a problem with the ISS transmitter. Call Technical Support. See "Contacting Davis Instruments" on page 27.

See "SIM Board Display and Contents" on page 29 for information on locating the LED indicator light and the DIP switches.

Note: If the LED is flashing rapidly, call Technical Support. See "Contacting Davis Instruments" on page 27 for more information.

If the console is still not receiving readings, ensure that the console is in Setup Mode and reboot the console by disconnecting the AC power adapter from the console and removing the console batteries for at least 30 seconds. If the console is still not displaying sensor readings from the ISS, please contact Davis Technical Support.

Wireless ISS Assembly

The ISS has a wireless connection to a Vantage Pro2 wireless console. Once the anemometer has been installed and the sensors have been checked, the ISS must be powered and a wireless communication channel must be established between the ISS and the console. Follow the steps below for powering the ISS and establishing a connection to the console.

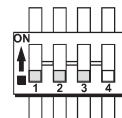
- Applying Power to a Wireless ISS
- Verifying Communications with the Console
- Verifying Data from the ISS Sensors
- Troubleshooting ISS Reception

Applying Power to a Wireless ISS

1. Insert the 3-volt lithium battery into the SIM.
Once powered, the ISS immediately begins transmitting data to the console. Be sure to match the "+" sign on the battery with the "+" sign on the SIM. See "SIM Board Display and Contents" on page 29.
The SIM stores energy from the solar panel for power at night. The battery is an alternative power source the SIM uses when it is depleted of energy.

Checking Transmitter ID

A Vantage Pro2 console can receive data from up to eight different wireless stations. The default Transmitter ID for the ISS and console is 1.



Settings for Transmitter ID 1:
DIP Switch 1 = OFF
DIP Switch 2 = OFF
DIP Switch 3 = OFF

In most cases it will not be necessary to change the Transmitter ID. The console and ISS should begin communicating automatically when power is applied.

Note: If it is necessary to change the Transmitter ID, remember to use the same ID for the ISS and console. See "SIM Board Display and Contents" on page 29 for locating the components and points of interest on the SIM board.

Verifying Communication with the Console

1. Power the console if it does not already have power. Refer to the *Vantage Pro2 Console Manual* and apply power to the console.
The console automatically enters Setup Mode when powered up.
2. If the console is not in Setup Mode, press and hold DONE then press the down arrow.
The message RECEIVING FROM... and STATION NO. followed by the Transmitter IDs that the console detects displays on the console screen.
3. Look for the ISS Transmitter ID. The number 1 displays unless the Transmitter ID has been changed. If the console displays the ISS Transmitter ID, the ISS is detected.

Note: If the console does not display the number of the ISS Transmitter ID setting, see "Troubleshooting Wireless ISS Reception" on page 12 for more information. It can take several minutes for the console to acquire and display all the available Transmitter IDs.

4. Press and hold DONE to view ISS data once the ISS Transmitter ID displays.
-

Verifying Data from the ISS Sensors

Use these steps to verify reception of ISS data at the wireless Vantage Pro2 console and to test the operation of the ISS sensors.

1. Press and hold DONE until the Current Weather screen displays, if the console is in Setup Mode.
Sensor readings from the ISS should display on the screen.
2. Near the center of the screen, look for the outside temperature.
3. Spin the wind cups to check wind speed, pressing WIND if necessary to alternate between speed and direction in the compass rose.
4. Turn the wind vane, and allow 5 seconds for the wind direction display to stabilize before moving it again.
Approximately one minute after power-up the outside relative humidity reading should be displayed on the console.
5. If the ISS contains a UV sensor and/or solar radiation sensor, press 2ND and then press RAIN YR for current ultraviolet readings or press 2ND then press RAIN DAY for solar radiation readings.
The UV reading displays in the center of the console. The solar reading displays in the bottom right corner of the console display. UV and solar readings should be zero or close to zero if the ISS is inside. Zero is a valid reading — dashes are displayed if no data comes from the sensors.
6. Current weather data displayed on the console confirms successful communication.

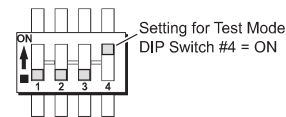
Once the ISS has been powered and the console has successfully received accurate readings from all the sensors, prepare the ISS for installation. Continue on to “Preparing the ISS for Installation” on page 15 for more information.

If the communication problems still exist between the wireless ISS and the console, see “Troubleshooting Wireless ISS Reception.”

Troubleshooting Wireless ISS Reception

If the console isn't displaying data from the ISS, perform the following steps:

1. Verify that the console is powered and is not in Setup Mode.
2. Make sure that all ISS sensor cables are firmly connected to the SIM and the ISS battery is properly installed.
3. Walk around the room with the console, standing for a few moments in various locations, to see if you are picking up signals from the ISS. Look on the screen's lower right corner. An “X” toggles on and off when the console receives a transmission.
4. If you do not see the “X” slowly blinking, no matter where you stand with the console, put your ISS in Test Mode.
 - The DIP switch #4 on the SIM is the Test Mode switch. Switch it to the ON position, using a ball-point pen or paper clip.
 - An LED indicator light on the SIM flashes each time the ISS transmits, which is about once every 2.5 seconds.



Note: If the LED is flashing rapidly, call Technical Support. See “Contacting Davis Instruments” on page 27 for more information.

See “SIM Board Display and Contents” on page 29 for information on locating the components and points of interest on the SIM board.

5. If the LED remains dark, there is a problem with the ISS transmitter. Call Technical Support. See “Contacting Davis Instruments” on page 27.
 6. If the LED flashes repeatedly but your console isn’t picking up a signal anywhere in the room, it could be related to one of the following causes:
 - You changed the ISS Transmitter ID at the ISS or console, but not at both.
 - Reception is being disrupted by frequency interference from outside sources. Interference has to be strong to prevent the console from receiving a signal while in the same room as the ISS. In high-interference environments, it may be preferable to install the Cabled Vantage Pro2.
 - There is a problem with the console.
 7. If a problem with receiving the wireless transmission still exists, please contact Technical Support. See “Contacting Davis Instruments” on page 27.
 8. When you are finished testing wireless transmission, set DIP switch # 4 to OFF to take the SIM out of Test Mode.
-

Note: If the SIM is left in Test Mode, the blinking LED will significantly reduce ISS battery life.

Optional: Changing ISS Transmitter ID

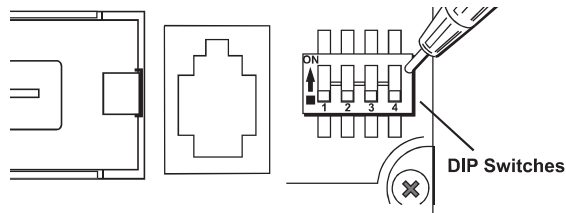
Each wireless transmitting station, including the Integrated Sensor Suite (ISS), uses one of eight selectable Transmitter IDs. DIP switches #1, 2 and 3 on the transmitter control the ID — or channel — the station transmits on. DIP switch #4 is used for transmission testing, not for the Transmitter ID.

Note: The transmitter on the ISS and receiver on the console communicate with each other only when both are set to the same ID.

The default Transmitter ID is 1 for both the ISS and the Vantage Pro2 console, and should work fine for most situations. Change the Transmitter ID if any of the following issues are true:

- Another Davis Instruments wireless weather station operating nearby already uses Transmitter ID 1.
- Additional Vantage Pro2 or Vantage Vue wireless transmitting stations have been purchased with the Vantage Pro2 or Vantage Pro2 Plus and one of the stations has been designated as Station No. 1 instead of the selected ISS.

On the ISS, the Transmitter ID is set using the DIP switches located on the Sensor Interface Module (SIM). To access the SIM, open the SIM housing cover. See “Open the SIM Box” on page 5.



Transmitter ID DIP Switches in Top-right Corner of SIM

To change to another ID, use a ballpoint pen or paper clip to toggle DIP switches #1, 2, and 3. The settings for Transmitter IDs 1 - 8 are shown in the table below. Set the Vantage Pro2 console to the same ID as the transmitters, as described in the *Vantage Pro2 Console Manual*.

ID CODE	SWITCH 1	SWITCH 2	SWITCH 3
#1 (default)	off	off	off
#2	off	off	ON
#3	off	ON	off
#4	off	ON	ON
#5	ON	off	off
#6	ON	off	ON
#7	ON	ON	off
#8	ON	ON	ON

Using Multiple Transmitting Stations

This table shows the maximum number of each type of station that can be used with a single Vantage Pro2 console. The console can receive signals from a **total** of up to eight transmitters (stations).

Station Type	Maximum Number
Integrated Sensor Suite (ISS)	1
Anemometer Transmitter Kit*	1
Leaf & Soil Moisture/Temperature Station	2**
Temperature Station	8
Temperature/Humidity Station	8

*Replaces the ISS anemometer.

**Two are allowable only if both stations are only partially populated. For example, a network can either have both a Leaf Wetness/Temperature station and a Soil Moisture/Temperature station, or it can have one combined Leaf Wetness and Soil Moisture/Temperature station.

Preparing the ISS for Installation

Once all the sensors have been connected and communication between the ISS and the console has been successfully established, continue to prepare the ISS unit for installation. The steps for preparing the ISS for installation are as follows.

- Close the SIM Box
- Prepare the Solar Panel
- Prepare the Rain Collector
- Site the ISS and Anemometer

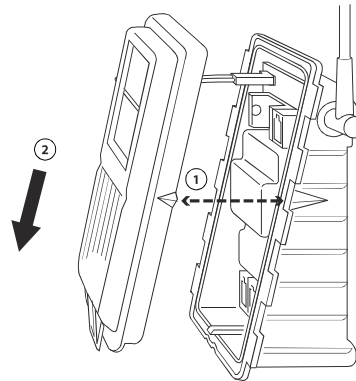
Close the SIM Box

To close the SIM box and continue assembling the ISS:

1. If the solar panel wire was disconnected during ISS assembly, reconnect the wire on the SIM box cover to the solar panel tab on the SIM board.

Note: See "SIM Board Display and Contents" on page 29 for information on locating the solar panel tab.

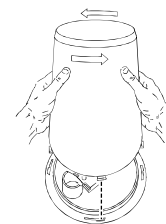
2. Find the two raised alignment indicator lines on both the SIM box and the SIM box cover. Match these alignment indicators as you place the cover against the box.
3. Slide the cover down until it snaps securely in place.



Prepare the Rain Collector

The tipping bucket is secured at the factory to protect it from damage during shipping. To use the ISS properly, the bucket must be released. To release the bucket:

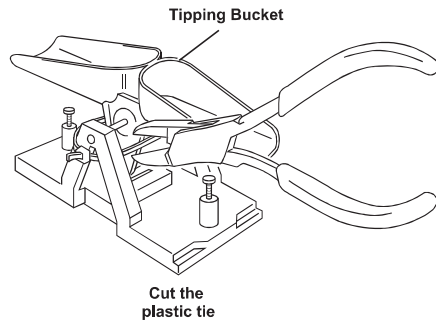
1. Remove the rain collector cone from the ISS base by rotating the cone counter-clockwise. When the cone's latches line up with openings in the base, lift the cone off the ISS base. When new, the cone fits tightly in the base and may require extra pressure to remove. Steady the ISS base between your knees when removing the cone.



Twist to Open

Prepare the Rain Collector

2. Carefully cut and remove the plastic tie that holds the tipping bucket in place during shipping (usually yellow or white in color).
3. On your console screen, look for the DAILY RAIN display. If the console is cabled to the ISS, reconnect the cable and see if the console is receiving rain readings.
4. While watching the daily rain display, tip the bucket until it drops to the opposite side, then wait to see if the display registers a rain reading. Each tip indicates 0.01" or 0.2 mm of rain and may take up to a minute to register at the console. If the bucket is tipped too quickly, the number on the console display may not change.
5. Temporarily reinstall the rain collector cone until you are ready to mount the ISS outside. If you are installing the metric measurement adapter, do not reinstall the rain collector cone.



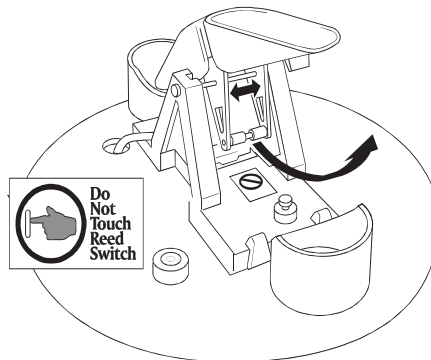
Optional: Insert the Metric Measurement Adapter

The rain collector tipping bucket mechanism contains a standard measurement weight magnet that takes measurements in 0.01" (US versions) or 0.2 mm (UK and EU versions). If you have a US version and would like to convert it to a metric measurement, follow these steps.

Note: EU and UK versions have the metric measurement installed at the factory.

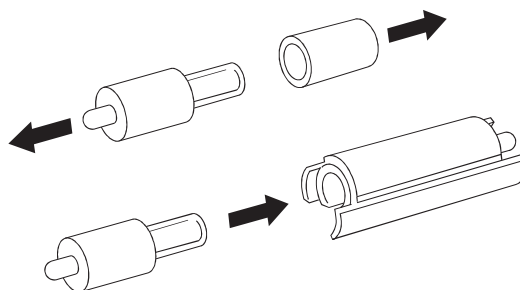
The ISS hardware kit contains a metric adapter that adjusts the weight of the tipping bucket mechanism so that it reports 0.2 mm metric measurements for every tip of the bucket. To install the metric adapter:

1. Find the metric adapter included in the hardware.
2. Locate the magnet between the arms of the bucket.
3. Open the arms slightly with one hand while pulling the magnet out with the other.



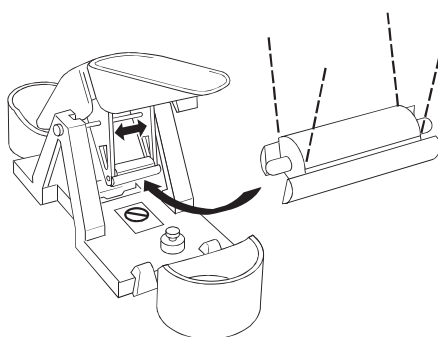
Open plastic tipping mechanism arms, pull out magnet

4. Separate an end cap from one end of the magnet.



Separate magnet from one end cap
Insert magnet with other end cap into metric measurement adapter

5. Slide the magnet, exposed end of magnet first, into the open slot of the metric adapter.
6. Insert the metric adapter and magnet between the arms of the bucket, with the solid side of the metric adapter facing up.



Open plastic arms to insert metric measurement adapter,
with adapter in "V" position

Note: The above procedure converts the collector to 0.2 mm measurements. The console must be set accordingly. See the *Vantage Pro2 Console Manual* for more information.

Locating the ISS and Anemometer

For the weather station to perform at its best, use these guidelines to select the optimum mounting locations for the ISS and anemometer. Be sure to take into consideration ease of access for maintenance, sensor cable lengths and wireless transmission range when siting the station.

Note: When selecting a location for installing your ISS, especially on a rooftop, make sure it is a location far from power lines. Seek professional help if you uncertain about the safety of your installation.

General ISS Siting Guidelines

- Place the ISS away from sources of heat such as chimneys, heaters, air conditioners and exhaust vents.
- Place the ISS at least 100' (30 m) away from any asphalt or concrete roadway that readily absorbs and radiates heat in the sun. Avoid installations near fences or sides of buildings that receive a lot of sun during the day.
- Ideally, place the radiation shield of the ISS 5' (1.5 m) above the ground in the middle of gently sloping or flat, regularly mowed grassy or naturally landscaped area that drains well when it rains. For areas with average maximum yearly snow depths over 3' (0.9 m), mount the ISS 2' (0.6 m) above this depth.
- Never install the ISS where it will be directly sprayed by a sprinkler system because it will adversely affect the readings.
- Avoid installations near bodies of water such as swimming pools or ponds.
- Do not locate the ISS under tree canopies or near the side of buildings that create "rain shadows." For heavily forested areas, site the ISS in a clearing or meadow.
- Site the ISS in a location with good sun exposure throughout the day if the ISS is wireless or includes solar radiation or UV radiation sensors.

For *agricultural applications* (important for evapotranspiration (ET) calculations):

- Install the ISS and anemometer as a single unit with the radiation shield 5' (1.5 m) above the ground and in the middle of the farm between similar crop types (i.e. two orchards, two vineyards or two row crops), if possible.
- Avoid areas exposed to extensive or frequent applications of agricultural chemicals (which can degrade the sensors).
- Avoid installation over bare soil. The ET formula works best when the ISS is installed over well-irrigated, regularly mowed grass.
- If the last three guidelines cannot be met, install the weather station at the edge of the primary crop of interest.

Anemometer Siting Guidelines

- For best results, place the anemometer at least 7' (2.1 m) above surrounding obstructions such as trees or buildings that obstruct wind flow.
- If mounting on a roof, mount the anemometer at least 7' (2.1 m) above the roof apex (when using a Mounting Tripod, install the anemometer at the very top of the pole).
- If mounting the ISS and the anemometer together, such as on a pole or a wooden post, mount the anemometer so it is at least 12" (0.3 m) above the top of the rain collector cone for best results.
- The standard for meteorological and aviation applications is to place the anemometer 33' (10 m) above the ground. Seek professional help for this type of installation.
- The standard for *agricultural applications* is to place the anemometer 6' (2 m) above the ground. This is important for evapotranspiration (ET) calculations.

Note: For roof mounting, and ease of installation, we recommend using the optional mounting tripod (#7716). For other installations, use the Mounting Pole Kit (#7717).

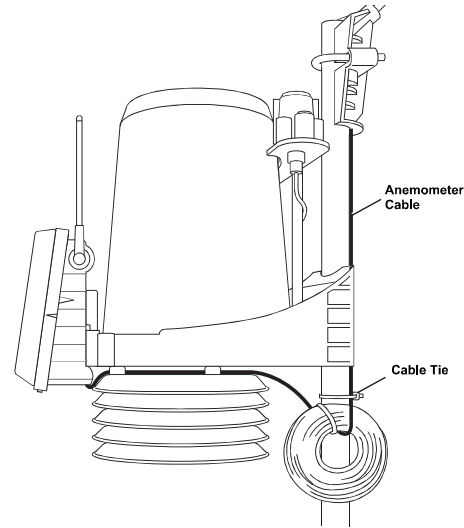
Note: For more detailed siting suggestions, see Application Note #30: Reporting Quality Observations to NOAA on the Davis Support web site (<http://www.davisnet.com/support/weather>).

Optional: Anemometer Cable Length Considerations

- All Vantage Pro2 stations include a 40' (12 m) cable to go between the ISS and the anemometer. This can be extended up to 540' (165 m) using optional extension cables purchased from Davis Instruments.
- If most of the anemometer cable length is unused, the coiled cable length can be stowed once the anemometer and ISS have been installed on a site. Attaching the anemometer cable to the mounting pole using the supplied cable tie is the recommended option.

Keep the anemometer cable coiled if possible during the ISS and anemometer assembly so that it is easily stowed once installation is complete.

- The Cabled Vantage Pro2 includes a 100' (30 m) cable to go between the console and the ISS. This can be extended up to 1000' (300 m) using optional cables.



Optional: Wireless Transmission Considerations

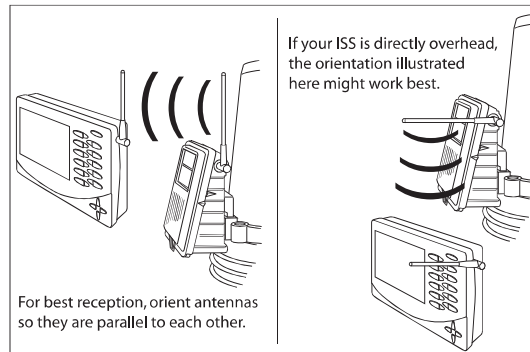
The range of the radio transmission depends on several factors. Try to position the transmitter and the receiver as close as possible for best results.

Typical maximum ranges include:

- Line of sight: 1000' (300 m).
- Under most conditions: 200 - 400' (60 - 120 m).

Other range and transmission considerations include:

- Range may be reduced by walls, ceilings, trees, foliage, a metal roof or other large metal structures or objects such as aluminum siding, metal ducts, and metal appliances, such as refrigerators, televisions, heaters, or air conditioners.
- Frequency interferers also reduce transmission distance. Cordless phones (900 Mhz) are a common example of frequency interference.
- Transmission between wireless units may be obscured by something unidentifiable, or by some obstacle that can't be worked around.
- For best results, orient the ISS antenna and the console antenna so that the orientation and angles of the antennas are parallel to each other.



- If possible, align the pivot joints of both the ISS and the console antennas so that they are facing each other for maximum signal strength.
- The ISS and console antennas do not rotate in a complete circle. Avoid forcing the antennas when rotating it.
- Turn the gain on to improve reception of a weak signal. Refer to the *Vantage Pro2 Console Manual* for information on setting the console gain.
- Consider using a Wireless Repeater (#7626 or #7627) or Long-Range Wireless Repeater (#7653 or #7654) to strengthen the signal or to increase the distance between the ISS and the console.

Testing Wireless Transmission at ISS Location

After a suitable place has been found for the wireless ISS, it is very important to test reception from the installation location before permanently mounting it there.

1. Set the ISS in the desired installation location.
2. Set the console in the desired location.
3. Press and hold TEMP and press HUM to display statistical and reception diagnostics on the console.
 - It's a good idea to test the console's reception anywhere that you might want to use or mount it now or in the future. Take your time. If you aren't picking up a strong signal where you intend to place your console, try rotating the antenna on the console and ISS or try moving the console and ISS to different positions.
 - Irregular terrain in the area may interfere with the signal. For example, if the ISS is mounted downhill from the console, the ground may block a large percentage of the transmitted signal.
4. Press and hold DONE to return to the Current Weather Mode when finished testing.

Note: See the Troubleshooting section of the *Vantage Pro2 Console Manual* for information on how to check wireless signal strength and for more information on troubleshooting reception problems.

Installing the ISS

The anemometer and the main part of the ISS can be installed either together as a single unit on a pole, or apart from each other. The main part of the ISS includes the rain collector, the temperature and humidity sensors, the radiation shield, and the SIM housing. Use the U-bolts to install the ISS and anemometer together or separately on a pole. Use the lag screws to install them separately on a flat, vertical surface.

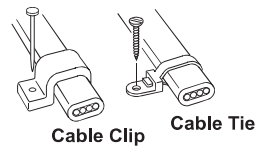
- The anemometer comes with a 40' (12 m) cable for flexibility in configuring the system to monitor wind conditions. For example, the anemometer could be mounted at the highest point of a roof, and the ISS could be mounted on a fence closer to ground level.

General ISS Installation Guidelines

- Install the ISS as level as possible to ensure accurate rain measurements. Use the built-in bubble level (under the rain collector cone, near the tipping bucket mechanism) or carpenter's level to make sure the ISS is level.
- In the Northern Hemisphere, the solar panel should face south for maximum sun exposure.
- In the Southern Hemisphere, the solar panel should face north for maximum sun exposure. Either install the ISS and anemometer separately, each facing north, or mount them as a single unit with solar panel facing north and the wind vane re-oriented to the South.

Optional: Guidelines for Securing Cables

- To prevent fraying or cutting of cables, secure them so they will not whip about in the wind.
- Secure cable to a metal pole using cable ties or by wrapping tape around both the cables and the pole.
- Place clips or ties approximately every 3' – 5' (1 – 1.6 m).
- Mounting clips, cable ties or additional hardware not included with your station can be easily obtained at a hardware or electronics store.



Note: Do not use metal staples or a staple gun to secure cables. Metal staples — especially when installed with a staple gun — have a tendency to cut the cables.

Orient the Wind Vane

The wind vane rotates 360° to display current and dominant wind directions on the compass rose of the console display. To obtain accurate readings, the vane must be *correctly oriented* when mounting the anemometer outside. By default, the wind vane reports the correct wind direction if the anemometer arm points true north.

To ensure correct orientation of the wind vane, mount the anemometer so that the arm points true north.

The wind vane will be ready for use immediately.

If your anemometer arm cannot be mounted aiming true north, you will need to calibrate the wind direction on your console to display accurate wind directions. See your *Vantage Pro2 Console Manual*.

Installation Instructions

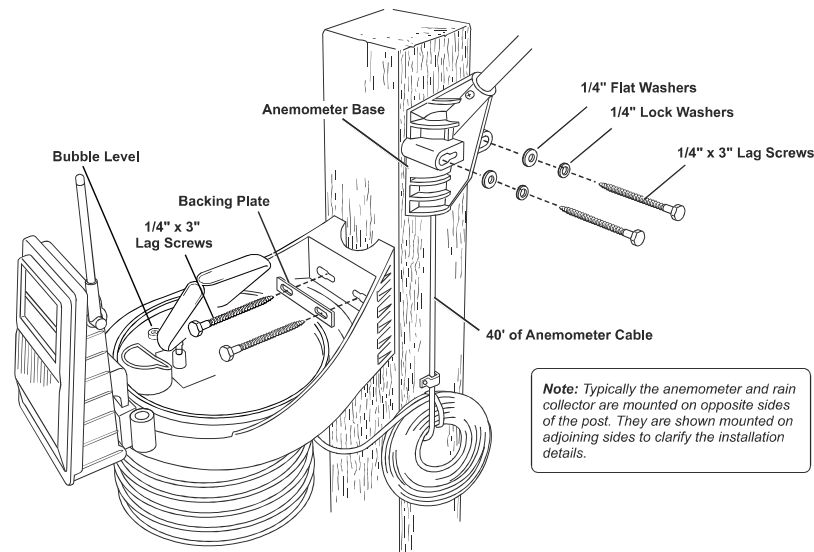
There are several ways to mount and install the ISS unit. The following are installation types that Davis Instruments recommends. Individual ISS locations and installations may vary.

- Installing the ISS on a flat surface
- Installing the anemometer on a post or flat surface
- Installing the ISS on a pole

Note: All installations require that the rain collector cone be removed for assembly. Use the built-in bubble level to ensure the main part of the ISS is level.

Installing the ISS on a Flat Surface

Refer to the following illustration to install the ISS on a post or flat, vertical surface.



Option 1: Installing the ISS on a Post or Flat Surface

1. With a 3/16" (5 mm) drill bit, drill two holes approximately 2 1/8" (54 mm) apart. Use a carpenter's level to ensure the holes are level. Use the metal backing plate as a guide when marking the holes.
2. Remove the rain collector cone if it is installed on the ISS mounting base.
3. Insert the 1/4" x 3" lag screws through the metal backing plate and the holes in the mounting base into the post. Make sure the ISS is level by checking the built-in bubble level.
4. Tighten the lag screws using an adjustable wrench or 7/16" wrench.
5. Re-attach the rain collector cone. Set the cone back on the base so its latches slide downward into the latch openings on the base. Rotate cone clockwise.
6. Place the debris screen (shown in the illustration on page 1) inside the cone, "feet-down" over the funnel hole.

Option 2: Installing the Anemometer on a Post or Flat Surface

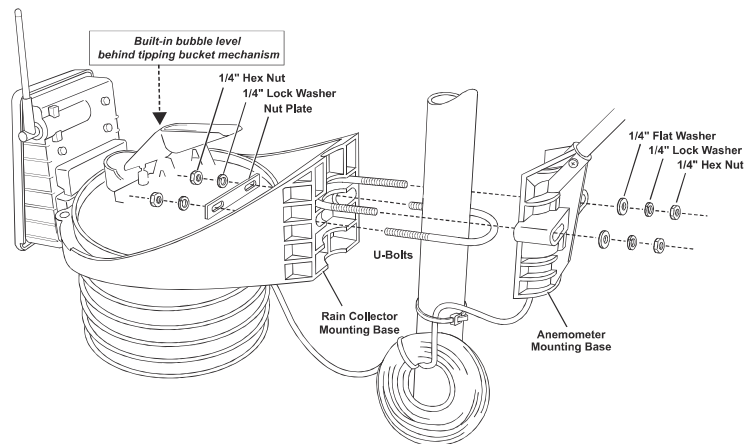
1. With a 3/16" (5 mm) drill bit, drill two holes approximately 2 1/8" (54 mm) apart. Use a carpenter's level to ensure the holes will be level.
2. Insert the 1/4" x 3" lag screws through the flat washers and the holes in the anemometer mounting base into the post.
3. Tighten the lag screws using an adjustable wrench or 7/16" wrench.

Note: If your anemometer cannot be mounted aiming true north, you will need to calibrate the wind direction on your console to display accurate wind directions. See your *Vantage Pro2 Console Manual*.

Installing the ISS on a Pole

When installing the ISS on a pole, the rain collector and radiation shield section of the ISS can be mounted as a single unit with the anemometer section, or the two sections can be mounted separately.

Refer to the following illustration when installing the ISS and/or anemometer on a pole.

**Accessories for Pole Mounting**

- Use the Mounting Tripod (#7716) for easy roof-mounting.
- Use the Mounting Pole Kit (#7717) to raise the installation height of the ISS by up to 37.5" (0.95 m).

General Guidelines for Installing on a Pole

- With the supplied U-bolts, the ISS and anemometer can be mounted on a pole having an outside diameter ranging from 1 1/4" to 1 3/4" (32 – 44mm).
- Larger U-bolts (not supplied) can be used to mount to a pole with a maximum outside diameter of 2 1/2" (64mm).
- To mount on a smaller pole, obtain a U-bolt that fits the base openings but that has a shorter threaded section. If mounting on a smaller pole with the included U-bolts, the bolt interferes with the rain collector cone.
- Use the built-in bubble level to ensure ISS is level.

Guidelines for Installing the ISS on a Pole

- When mounting the ISS and anemometer together on opposite sides of the pole, remember that whichever side is mounted first, the U-bolt from the opposite side must also be placed around the pole before tightening the U-bolts. (If it is not, there is no way to slide it in later.)
- In each side's mounting base, there is a groove to accommodate the other's U-bolt.
- Once the two sides of the ISS have been loosely mounted together on the pole, swivel the unit to the correct direction and then tighten the hex nuts. The desired height can also be achieved by sliding the ISS vertically.

Option 1: Installing ISS and Anemometer Together

Try to install the ISS so the anemometer arm is aiming north.

Note: If your anemometer arm cannot be mounted aiming true north, you will need to calibrate the wind direction on your console to display accurate wind directions. See your *Vantage Pro2 Console Manual*.

1. Place the U-bolt for the anemometer around the pole so that its round end fits in the top groove of the side of the rain collector side's plastic mounting base. The groove is right above two large holes.
2. While holding the mounting base of the rain collector against the pole, place the two ends of the remaining U-bolt around the pole and through the two holes in the base.
3. Slide the metal backing plate over the bolt ends as they stick out over the rain collector base. Secure the backing plate with a lock washer and hex nut on each of the bolt ends as shown previously.

Note: Do not tighten the hex nuts yet. Leave the hex nuts loose to swivel the ISS base on the pole.

4. The two ends of the anemometer's U-bolt should now be pointing away from the mounted rain collector side. Slide the anemometer's mounting base over the protruding bolt ends. Place a flat washer, a lock washer and a hex nut on each of the bolt ends as shown above. Do not tighten the nuts yet.
5. Raise the ISS unit to the desired height on the pole and swivel it so the anemometer arm is pointing north.
6. Using an adjustable wrench or 7/16" wrench, tighten all four hex nuts until the ISS is firmly fastened on the pole.
7. Re-attach the rain collector cone by setting the cone back on the base so its latches slide downward into the latch openings on the base, then rotate cone clockwise.
8. Place the debris screen (shown in the illustration on page 1) inside the cone, "feet-down," over the funnel hole. When installing the ISS as a single unit, we recommend tucking the coil of anemometer cable between the rain collector cone and the ISS base.

Option 2: Installing ISS Only

1. While holding the mounting base against the pole, place the two ends of a U-bolt around the pole and through the two holes in the base.
2. Slide the metal backing plate over the bolt ends as they stick out toward the rain collector cone. Secure the backing plate with a washer, a lock washer, and a hex nut on each of the bolt ends. Do not tighten the nuts yet.

For the wireless ISS, swivel the ISS base so the solar panel is facing south (in the Northern Hemisphere), or north (in the Southern Hemisphere).

3. Tighten the hex nuts using an adjustable wrench or 7/16" wrench.
4. Re-attach the rain collector cone.
Set the cone back on the base so its latches slide downward into the latch openings on the base. Rotate the cone clockwise.
5. Place the debris screen (shown in the illustration on page 1) inside the cone, "feet-down," over the funnel hole.

Option 3: Installing Anemometer Only

1. While holding the mounting base against the pole, place a U-bolt around the pole and through the two holes in the base.
2. Place a flat washer, a lock washer and a hex nut on each of the bolt ends.
3. Swivel the anemometer until the arm is pointing north.

Note: If your anemometer arm cannot be mounted aiming true north, you will need to calibrate the wind direction on your console to display accurate wind directions. See your *Vantage Pro2 Console Manual*.

Finishing the Installation

Level the Solar and UV Sensors

If you have a Vantage Pro2 Plus station that includes a solar radiation or UV sensor, use the bubble level on the sensors as a guide to verify that the sensors are level.

Adjust the level by tightening or loosening the screws that hold each sensor onto the shelf.

Note: If you are installing the solar or UV sensors separately, see the Sensor Mounting Shelf installation manual and the Solar Radiation and UV Sensor installation manuals for more information.

Clearing Data Collected During Testing and Installation

Now that the ISS is mounted outside, any data that was collected in the Vantage Pro2 console during testing and mounting can be cleared.

To clear all the collected data on the console:

1. Press WIND so that graph icon appears adjacent to the wind data on the display.
Confirm that wind speed is displayed on the compass rose.
2. Press 2ND, then press and hold CLEAR for at least six seconds and until you see "CLEARING NOW" in the console ticker display.

Additional Mounting Option

Extending Wireless Transmission Range

Optional repeater stations can be used to extend the wireless transmission range.

- Wireless Repeater, AC-Powered (#7626)
- Wireless Repeater, Solar-Powered (#7627)
- Long-Range Wireless Repeater, AC-Powered (#7653)
- Long-Range Wireless Repeater, Solar-Powered (#7654)

Extending the Console Cable (Cabled ISS Only)

A cabled ISS can be extended up to 1000' (300 m) away from the console by using Davis Instruments extension cables (#7876).

Relocating the Anemometer

Using Extension Cables:

Note: Not all cables are compatible with your Vantage Pro2 system. To be sure they will work, order Davis extension cables from your dealer or directly from Davis Instruments.

The anemometer can be extended further than 40' from the ISS by using Davis Instruments extension cables (#7876).

Be aware that the maximum measurable wind speed reading decreases as the total length of cable from the anemometer to the ISS increases.

Note: If the cable length is greater than 540' (165m), the maximum measurable wind speed may be less than 100 MPH (161 km/h).

Using the Anemometer Transmitter Kit (Wireless ISS Only)

Use the Anemometer Transmitter Kit (#6332) to add an independent wireless transmitter to the anemometer. The kit allows the anemometer to function as a transmitter station sending wind data directly to the console, instead of transmitting via the ISS.

Remote Mounting the Solar Radiation and UV Sensors

The solar radiation and UV sensors have a 3' (0.9 m) cable. If you wish to install these sensors away from the ISS, you can extend the length of the sensor cables up to 125' (38 m) with Davis Instruments extension cables (#7876).

Optional Wireless Stations

You may use our optional wireless sensor stations to collect weather measurements, without the inconvenience of routing cables.

- Wireless Temperature Station (#6372)
- Wireless Temperature/Humidity Station (#6382)
- Wireless Leaf & Soil Moisture/Temperature Station (#6345)

For more details, please visit our website or see the most recent *Davis Precision Weather Instruments* catalog.

Maintenance and Troubleshooting

Maintaining UV and Solar Radiation Sensors

If the ISS is a Plus model and contains UV and solar radiation sensors, do not touch the small white diffusers on top of the sensors. Oil from skin reduces their sensitivity. If you are concerned that you have touched the diffusers at any time, clean the UV diffuser using ethyl alcohol with a soft cloth. When cleaning the UV diffuser, DO NOT use rubbing or denatured alcohols because they can affect accuracy of the sensor readings. Ethyl alcohol can be procured through an industrial or laboratory supply store. Clean the solar diffuser with a soft damp cloth.

Due to the sensitivity of ultraviolet and solar radiation sensors it is common practice for manufacturers to recommend re-calibration after a period of time. Users demanding high accuracy typically recalibrate their sensors annually. Here at Davis Instruments, we have seen less than 2% drift per year on the readings from these sensors.

Contact Technical Support about returning your sensor for calibration. See "Contacting Davis Instruments" on page 27.

Cleaning the Radiation Shield

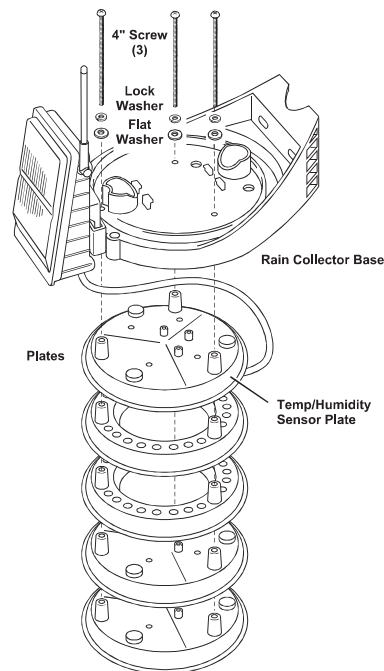
The outer plating of the radiation shield should be cleaned when there is excessive dirt and build-up on the plating. Use a damp cloth to clean the outer edge of each ring.

Note: Spraying down or using water excessively to clean the radiation shield can damage the sensitive sensors or alter the data and readings the ISS is transmitting.

Check the radiation shield for debris or insect nests at least once a year and clean when necessary. A buildup of material inside the shield reduces its effectiveness and may cause inaccurate temperature and humidity readings.

To thoroughly clean the radiation shield:

1. Remove the rain collector cone.
2. Using a Phillips head screwdriver, loosen the three 4" (~100mm) screws holding the radiation shield plates together.
3. Taking care to maintain the order in which the five plates are assembled, separate the plates as shown and remove all debris from inside the shield.



Troubleshooting

Note: For some models of the ISS, the order in which the five radiation shield plates are assembled may be slightly different than the order shown in the figure on page 25. For this reason, ensure that you always reassemble the plates in the same order in which they were disassembled.

4. Reassemble the plates in the same order in which they were disassembled, and fasten them together using a Phillips head screwdriver to tighten the 4" screws, as shown in the illustration.

Cleaning the Rain Collector Cone

To maintain accuracy, thoroughly clean the rain collector several times a year.

Note: Cleaning the rain collector and tipping buckets may cause false rain readings. Unplug the RAIN sensor from the SIM before cleaning so that no inaccurate readings are logged, or clear the weather data that was logged on the Vantage Pro2 console after cleaning is complete. See your *Vantage Pro2 Console Manual* for instructions on clearing weather data.

1. Separate the cone from the base by turning it counter-clockwise.
2. Use a soft, damp cloth to remove any debris from the cone, cone screen, and tipping bucket.
3. Use pipe cleaners to clear the funnel hole in the cone and drain screens in the base.
4. When all parts are clean, rinse with clear water.
5. Re-attach the cone and replace the debris screen.

Troubleshooting

If a Sensor Functions Intermittently

Carefully check all connections from the sensor to the ISS. See "Check SIM Sensor Connections" on page 4.

Loose connections account for a large portion of potential problems. Connections should be firmly seated in receptacles and plugged in straight. To check for a faulty connection, try jiggling the cable while looking at the display. If a reading displays intermittently on the console as the cable is jiggled, the connection is faulty. Try removing and then re-installing the cable to correct the faulty connection. If the sensor still functions intermittently contact Technical Support. See "Contacting Davis Instruments" on page 27.

Most Common Rain Collector Problem

If the rain collector seems to be under-reporting rainfall, remove the rain collector cone to clean the tipping bucket and clear out any debris. Make sure the cable tie around the tipping bucket has been cut and removed.

Most Common Anemometer Problems

"The anemometer head is tilted when I mount the anemometer."

With the Allen wrench provided in the supplied hardware, loosen the screws holding the anemometer head on the arm. (The screws are on the bottom of the anemometer head, by the wind cups.) Turn the anemometer head so it is straight and then tighten the screws.

“The wind cups are spinning but my console displays 0 mph.”

The signal from the wind cups may not be making it back to the display. Remove the cups from the anemometer (loosen the set screw). Put the cups back onto the shaft and make sure to slide them up the shaft as far as possible. Check your cables for visible nicks and cuts. Look for corrosion in the WIND connector on the SIM and on splices in the cable. If using an extension cable, remove it and test using only the anemometer cable. Contact Technical Support and ask for a wind test cable if the problem has not been resolved.

Note: If the anemometer is sending no data, the wind display indicates 0 speed and a north direction.

“The wind direction is stuck on north, or displays dashes.”

It is likely that there is a short somewhere between the wind vane and the display. Check the cables for visible nicks and cuts. Look for corrosion in the “WIND” jack on the SIM and on splices in the cable (if any). If possible, remove any extensions and try it with the anemometer cable only. If none of these steps get the wind direction working, contact Technical Support and ask for a wind test cable.

“The wind cups don’t spin or don’t spin as fast as they should.”

The anemometer may be located where wind is blocked by something, or there may be friction interfering with the cups’ rotation. Remove the wind cups (loosen the set screw) and clear out any bugs or debris. Turn the shaft the cups rotate on. If it feels gritty or stiff, contact Davis Technical Support.

Note: Do not lubricate the shaft or bearings in any way. When replacing the cups, make sure they are not rubbing against any part of the anemometer head.

“Readings aren’t what I expected them to be.”

Comparing data from your ISS to measurements from TV, radio, newspapers, or a neighbor is NOT a valid method of verifying your readings. Readings can vary considerably over short distances. How you site the ISS and anemometer can also make a big difference. If you have questions, contact Technical Support.

Contacting Davis Instruments

If you have questions about the ISS or Vantage Pro2 system, or encounter problems installing or operating the weather station, please contact Davis Technical Support.

Note: Please do not return items to the factory for repair without prior authorization.

(510) 732-7814 – Technical Support phone, Monday – Friday, 7:00 a.m. – 5:30 p.m. Pacific Time.

(510) 670-0589 – Technical Support Fax.

support@davisnet.com – E-mail to Technical Support.

info@davisnet.com – General e-mail.

www.davisnet.com – Download manuals and specifications from the Support section. Watch for FAQs and other updates. Subscribe to the e-newsletter.

Appendix

Specifications

Complete specifications for the ISS and other products are available in the Weather Support section of our website at www.davisnet.com.

Cabled ISS

Temperature range: -40 to 150° Fahrenheit (-40 to 65° Celsius)
Power input: Console cable from Vantage Pro2 console
Optional Vantage Pro2 AC power adapter

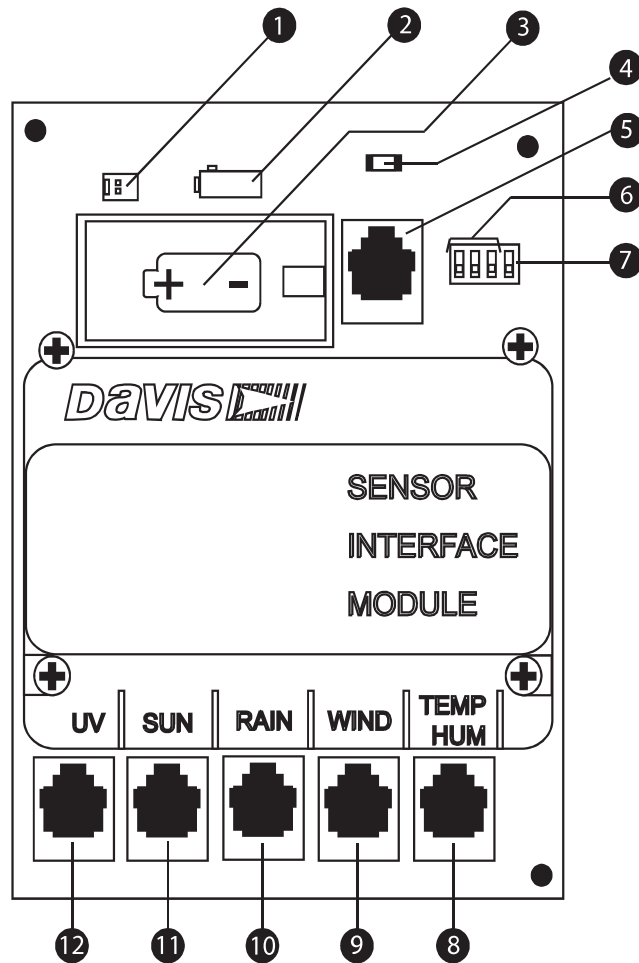
Wireless ISS

Temperature range: -40 to 150° Fahrenheit (-40 to 65° Celsius)
Transmission frequency: 902 - 928 MHz FHSS for North America
868.0 -868.6 MHz FHSS for overseas versions: EU, UK, and OV
Transmitter ID codes: 8 user-selectable
License: Low power (less than 8 mW), no license required
Primary power: Solar power – Davis solar charger
Backup power: CR-123A 3-volt lithium battery (8 months without sun-light- greater than 2 years depending on solar charging)
Alternate power AC power adapter

ISS Weather Variable Update Intervals (Transmitter ID Dependent)

Wind speed: 2.5 to 3 seconds
Wind direction: 2.5 to 3 seconds
Accumulated rainfall: 20 to 24 seconds
Rain rate: 20 to 24 seconds
Outside temperature: 10 to 12 seconds
Outside humidity: 50 seconds to 1 minute
Ultraviolet radiation: 50 seconds to 1 minute
Solar radiation: 50 seconds to 1 minute

SIM Board Display and Contents



- | | |
|-----------------------------|---|
| ① Solar Panel Tab | ⑦ Test DIP Switch |
| ② AC Adapter Socket | ⑧ Temperature/Humidity Sensor Connector |
| ③ Battery Socket | ⑨ Wind Sensor Connector |
| ④ Test LED | ⑩ Rain Sensor Connector |
| ⑤ Cabled Connection | ⑪ Solar Radiation Sensor Connector |
| ⑥ Transmitter ID DIP Switch | ⑫ UV Sensor Connector |

Vantage Pro2 Integrated Sensor Suite Installation Manual

Document Part Number: 7395.249

Rev G (January 27, 2010)

For Vantage Pro2 Weather Stations #6322, 6322C, 6323, 6327, 6327C, 6328

For Vantage Pro2 Plus Weather Stations #6152C, 6162C, 6152, 6162, 6153, 6163

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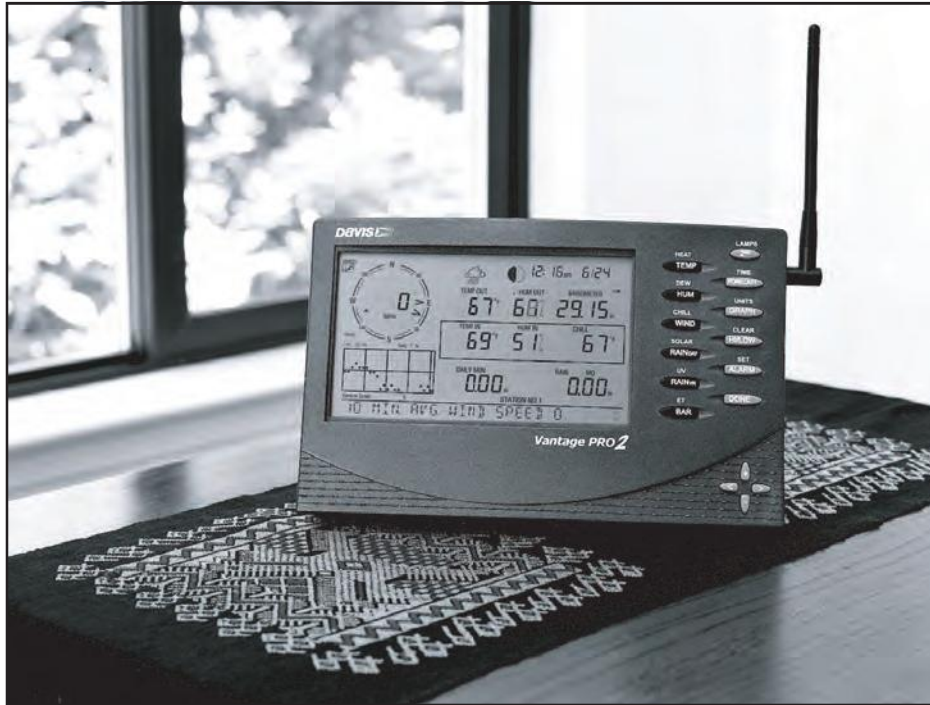
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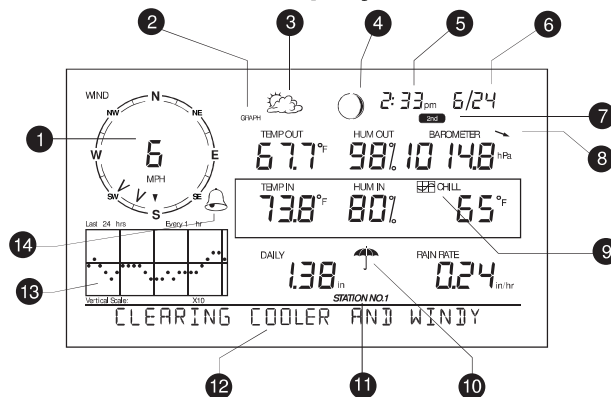
Vantage Pro2™ Console Manual

For Vantage Pro2™ & Vantage Pro2 Plus™ Weather Stations



Davis Instruments, 3465 Diablo Avenue, Hayward, CA 94545-2778 U.S.A. • 510-732-9229 • www.davisnet.com

Vantage Pro2 Console Display Features



Display Features

- | | |
|---------------------------------|------------------------------|
| 1. Compass Rose | 8. Barometric Trend Arrow |
| 2. Graph & Hi/Low Mode Settings | 9. Graph Icon |
| 3. Forecast Icons | 10. Current Rain Icon |
| 4. Moon Phase Indicator | 11. Station Number Indicator |
| 5. Time/Sunrise Time | 12. Weather Ticker |
| 6. Date/Sunset Date | 13. Graph Field |
| 7. 2ND Button Indicator | 14. Alarm Icon |

FCC Part 15 Class B Registration Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modification not expressly approved in writing by Davis Instruments may void the warranty and void the user's authority to operate this equipment.

FCC ID: IR2DWW6312

IC: 378810-6312

EC EMC Compliance

This product complies with the essential protection requirements of the EC EMC Directive 2004/108/EC; Low Voltage Directive 2006/95/EC; and Eco-Design Directive 2005/32/EC > .05 watt no-load adaptor.

Vantage Pro2 Console Manual

Document Part Number: 07395.234

Rev. J, 2/14/11

For Vantage Pro2 Consoles # 6312 & 6312C

And Vantage Pro2 Weather Stations # 6152, 6152C, 6153, 6162, 6162C, 6163

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Chapter 1

Welcome to Vantage Pro2™

Welcome to your Vantage Pro2 Weather Station console. The console displays and records your station's weather data, provides graph and alarm functions, and interfaces to a computer using our optional WeatherLink[®] software.

Vantage Pro2 stations are available in two basic versions: cabled and wireless. A cabled Vantage Pro2 station transmits outside sensor data from the Integrated Sensor Suite (ISS) to the console using a straight-through four-conductor cable. A wireless Vantage Pro2 station transmits outside sensor data from the ISS to the console via a low-power radio.

Note: Wireless consoles can also collect data from optional Vantage Pro2 sensors or a Davis Vantage Vue ISS, and can also retransmit data to other Vantage Pro2 or Vantage Vue consoles or a Davis Weather Envoy. You can have an unlimited number of consoles - one in each room!

The *Vantage Pro2 Quick Reference Guide* included with your station provides an easy to use reference for most console functions.

Console Features

Keyboard & Display

The keyboard lets you view current and historical data, set and clear alarms, change station models, enter calibration numbers, set up and view graphs, select sensors, and read the forecast. The keyboard consists of 12 command keys located next to the screen display and four navigation keys located below the command keys.

A weather variable or console command is printed on each command key. Just press a key to select the variable or function printed on that key.

Each command key also has a secondary function which is printed above the key on the console case. To select the secondary function, press and release 2ND (on the front of the console, upper right corner) and then immediately press the key for that function.

After pressing 2ND, the 2ND icon displays above the barometer reading on the screen for three seconds. All secondary key functions are enabled during this time. Keys resume normal operation after the icon disappears.

The + and - navigation keys, along with < and > navigation keys are used to select command options, adjust values, and to provide additional functions when used in combination with a command key.

A rectangular icon with the words "CHILL" and "WIND" stacked vertically.A rounded rectangular icon with the text "2ND" inside.

Console Modes

The console operates in five basic modes: Setup, Current Weather, Highs and Lows, Alarm, and Graph. Each mode lets you access a different set of console functions or display a different aspect of your weather data.

Vantage Pro2 Options

Optional Sensors & Transmitting Stations

Vantage Pro2 stations are extremely flexible. Use the following optional sensors and wireless stations to enhance the weather monitoring capabilities of your Vantage Pro2. See our web site for complete details:

www.davisnet.com.

Optional Sensor and Stations	Description
Anemometer/Sensor Transmitter Kit (#6332)	Provides more flexible anemometer placement for wireless stations. With Envoy8X, allows additional solar radiation, UV, temperature, rain or 3rd party (reporting 0-3 volt) sensors.
Vantage Connect (#6620)	Transmits data from remote ISS to WeatherLink.com via cellular connection.
Wireless Leaf & Soil Moisture/ Temperature Station (#6345)	Measures and transmits leaf wetness, soil moisture and temperature data. Also for use with GLOBE.
Wireless Temperature Station (#6372)	Measures and transmits temperature data.
Wireless Temperature/Humidity Station (#6382)	Measures and transmits air temperature and humidity data.
Solar Radiation Sensor (#6450)	Measures solar radiation. Required for calculating evapotranspiration (ET). Available for cabled and wireless stations. Requires Sensor Mounting Shelf (#6673).
Ultraviolet (UV) Radiation Sensor (#6490)	Measures UV radiation. Required for calculating the UV dose. Available for Cabled and Wireless stations. Requires Sensor Mounting Shelf (#6673).

Note: Optional wireless stations can only be used with Wireless Vantage Pro2 Stations.

Optional WeatherLink® Software

The WeatherLink software and data logger connect your Vantage Pro2 station directly to a computer, providing enhanced weather monitoring capabilities, a continuous preserved data record, and powerful Internet features. The WeatherLink data logger fits neatly on the console and stores weather data even when the computer is turned off.

WeatherLink Option	Description
WeatherLink for Windows, USB connection (#6510USB)	Includes WeatherLink software and USB data logger. Allows you to save and view your weather data on your PC.
WeatherLink for Windows, serial connection (#6510SER)	Includes WeatherLink software and serial data logger. Allows you to save and view your weather data on your PC.
WeatherLink for Macintosh OS X, USB connection (#6520)	Includes WeatherLink software and USB data logger. Allows you to save and view your weather data on your Mac.
WeatherLinkIP for Windows XP/ Vista/7 (#6555)	Requires a broadband router with available Ethernet port. Allows you to post your weather data directly to the Internet without a PC. Among other features, allows you to receive e-mail alerts of current weather conditions or simple alarm conditions.

Vantage Pro2 Options

WeatherLink Option	Description
WeatherLink for APRS, Windows version, with streaming data logger, serial connection (#6540)	Includes WeatherLink software and streaming serial data logger. Allows real-time display of current weather conditions for use with APRS (Automatic Position Reporting System), for HAM radio users.
WeatherLink for Alarm Output, for Windows, with streaming data logger, serial connection (#6544)	Includes WeatherLink software and streaming serial data logger. Gives you the ability to control external devices based on various combinations of weather trends and events.
WeatherLink for Emergency Response teams, Windows version, with streaming data logger, serial connection (#6550)	Includes WeatherLink software and streaming serial data logger. Allows real-time display of current weather conditions for use by emergency response teams.
WeatherLink for Irrigation Control, Windows version, with streaming data logger, serial connection (#6560)	Includes WeatherLink software and streaming serial data logger. Allows intelligent and efficient control of popular automated irrigation systems using weather data.

Optional Accessories

Accessories are available from your dealer or may be ordered directly from Davis Instruments.

Envoys: Wireless Weather Envoy (#6316,) Envoy8X (#6318)

Performs many of the same functions as a Vantage Pro2 console, but without a display. Use an Envoy to interface your wireless station to a computer, freeing the display for use elsewhere. Weather Envoy can receive the same number and combinations of stations as a Vantage Pro2 console; Envoy8X can receive up to 8 stations in any combination and create a large database.

Sensor Mounting Shelf (#6673)

Required for mounting the optional Solar Radiation and/or UV sensors. The mounting shelf attaches to the base of the rain collector on the ISS.

Additional Vantage Pro2 (#6312) or Vantage Vue Console (#6351)

Enjoy weather information in several rooms.

USB-to-Serial (DB-9) Cable (#8434)

Allows the Serial version of WeatherLink (#6510SER, 6540, 6550, 6560) to connect to a USB port on your computer.

Telephone Modem Adapter (#6533)

Required when connecting station to an external phone modem.

Extension Cables (#7876)

Allows you to place the Cabled Vantage Pro2 ISS further away from the console using the extension cable provided by Davis Instruments. Maximum cable length is 1000' feet (300 m).

- #7876-040 Cable, 40' (12 m)
- #7876-100 Cable, 100' (30 m)
- #7876-200 Cable, 200' (61 m)

Chapter 2

Installing the Console

The Vantage Pro2 console is designed to give extremely accurate readings. As with any precision instrument, use care in its assembly and handling. Although installing the console is relatively simple, following the steps outlined in this chapter and assembling the Vantage Pro2 correctly from the start will help ensure that you enjoy all of its features with a minimum of time and effort.

Powering the Console

Cabled Vantage Pro2 Stations

Cabled Vantage Pro2 consoles supply power to the Integrated Sensor Suite (ISS) through the console cable. Because of the added power consumption of the ISS, the cabled console requires an AC power adapter used as the main power supply. The console batteries provide backup power for up to four to six weeks.

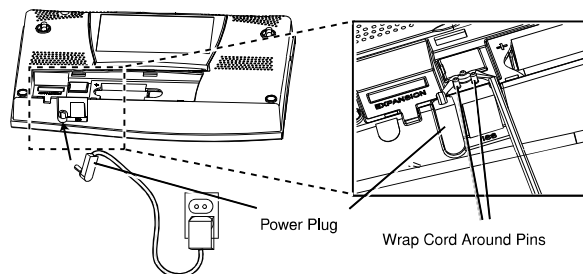
Wireless Vantage Pro2 Stations

Wireless Vantage Pro2 consoles do not require the use of an AC adapter. You may use the included adapter if you wish, but the three C-cell batteries should power a wireless console for up to nine months.

Note: When using an AC Power adapter, be sure to use the power adapter supplied with your Vantage Pro2 Console. Your console may be damaged by connecting the wrong power adapter. The console does not recharge the batteries. Because of this, and because NiCad batteries do not power the console as long as alkaline batteries, use alkaline batteries in the console.

Installing the AC Power Adapter

1. Remove the battery cover located on the back of the console by pressing down on the two latches at the top of the cover.
2. Find the power jack located on the bottom of the console case.

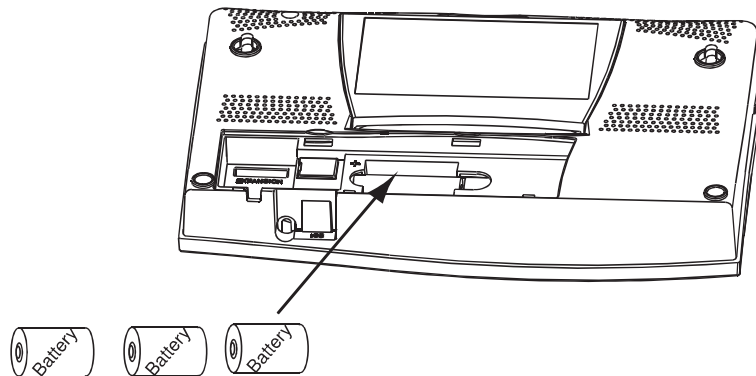


3. Insert the power adapter plug into the console power jack, then plug the other end of the adapter into an appropriate power outlet.

4. Check to make sure the console runs through a brief self-test procedure successfully. On power up, the console displays all the LCD segments and beeps twice. A message displays in the ticker banner at the bottom of the console, followed by the first screen that displays during Setup Mode. Press and hold DONE to skip the message and enter into Setup Mode.
Setup Mode guides you through steps required to configure the station. See “Setup Mode” on page 9 for more information.

Installing Batteries

1. Remove the battery cover located on the back of the console by pressing down on the two latches at the top of the cover.

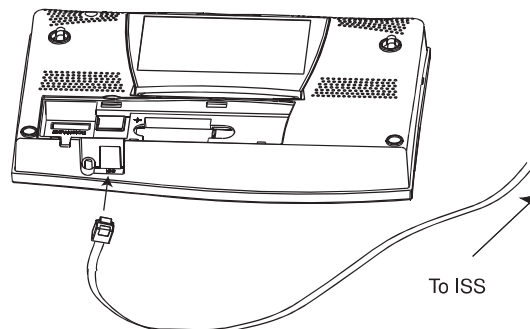


2. Insert three C batteries into the battery channel, negative (or flat) terminal first.
3. Replace the battery cover.

Connecting Cabled Stations

Cabled Vantage Pro2 stations come with 100 feet (30m) of cable. This cable is used for connecting the console to the ISS. Maximum cable length from ISS to the console using Davis Instruments cables is 1000 feet. To connect the console to the ISS:

1. Firmly insert the console end of the straight-through four-conductor wire into the console receptacle marked “ISS” until it clicks into place. Do not force the connector into the receptacle.



-
2. Ensure that the ISS cable is not twisted through the access port.
-

Note: The ISS must be assembled and connected to the console so that it is receiving power before the console connection can be tested.

Once the console and ISS are both powered up, cable connection should be tested and established.

Once the console is powered, it automatically enters Setup Mode. You can step through the Setup Mode options, or exit the Setup Mode to test the connection and sensor readings in Current Weather Mode. See “Setup Mode” on page 9 for Setup Mode options. See “Current Weather Mode” on page 18 for viewing and verifying current weather data coming from the cabled console.

To verify that the console is receiving data from the ISS through the console connection, see “Cabled ISS Assembly” in the *Integrated Sensor Suite Installation Manual*.

Console Location

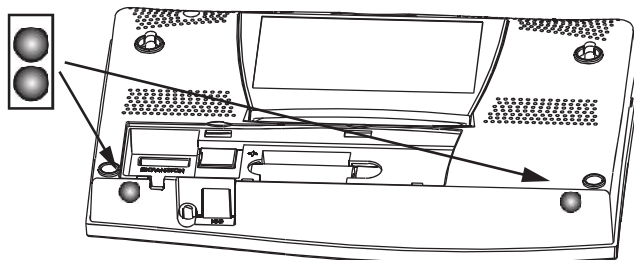
Place the console in a location where the keyboard is easily accessible and the display is easy to read. For more accurate readings:

- Avoid placing the console in direct sunlight. This may cause erroneous inside temperature and humidity readings and may damage the unit.
- Avoid placing the console near radiators or heating/air conditioning ducts.
- If you are mounting the console on a wall, choose an interior wall. Avoid exterior walls that tend to heat up or cool down depending on the weather.
- If you have a wireless console, be aware of possible interference from cordless phones or other devices. To prevent interference, maintain a distance of 10 feet between the Vantage Pro2 console and a cordless phone (handset and base).
- Avoid positioning a wireless console near large metallic appliances such as refrigerators, televisions, heaters, or air conditioners.
- The console antenna does not rotate in a complete circle. Avoid forcing the console antenna when rotating it.

Table & Shelf Placement

The console kickstand can be set to three different angles allowing five different display angles.

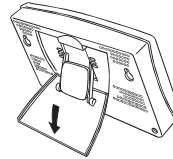
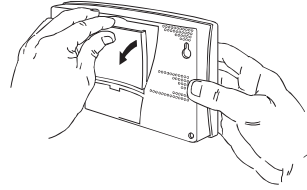
1. Install the two round rubber feet on the bottom of the console. The rubber feet help prevent damage to furniture and surfaces.



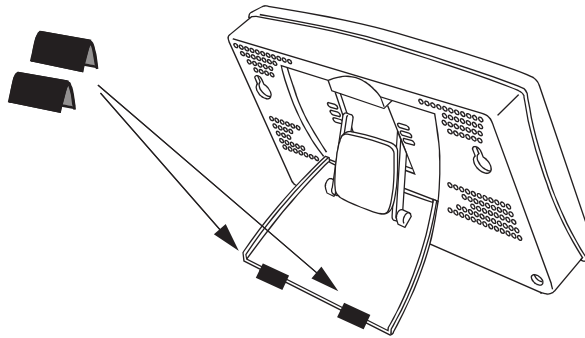
Console Location

2. Lean the kickstand out by pulling on its top edge.
You'll see the indentation for your finger at the top edge of the console.
3. Slide the catch to rest the kickstand in the appropriate angle.

Choose low angles for display on a coffee table or other low area. Choose higher angles for display on a desk or shelf.



4. Install the two rubber channel feet on the kickstand.

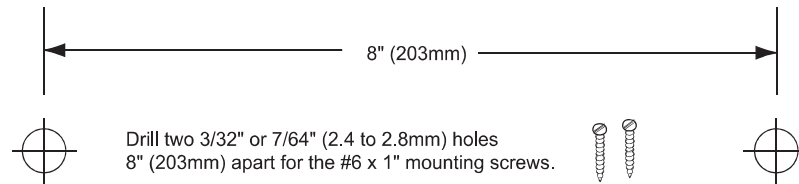


If necessary, pull up on the stand to close it. It will be a little tight, so it's okay to push hard enough to get it to slide.

Wall Mounting

The console mounts to the wall using two keyholes located on the back of the case. To mount the console on a wall:

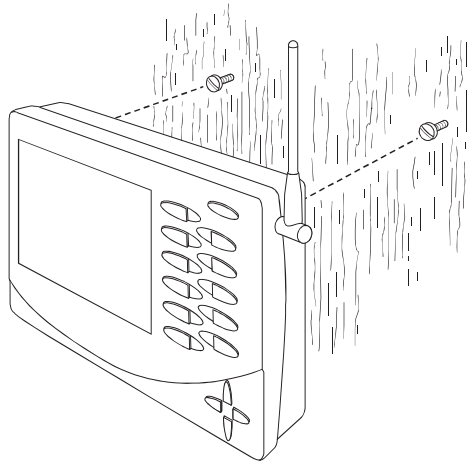
1. Use a ruler to mark two mounting hole positions on the wall 8 inches (203 mm) apart.



This is a representation for the mounting hole positions. This template is not true to size.

If installing a cabled Vantage Pro2 console with sensor cable running inside the wall, mount the console over an empty switch box.

2. Use a drill and a 3/32 or 7/64"(2.5 mm) drill bit to drill two pilot holes for the screws.
3. Using a screwdriver, drive the two #6 x 1" pan head self-threading screws into the wall. Leave at least 1/8" (3 mm) between the wall and the heads of the screws.
4. If the kickstand has been pulled out from the case, push it back into its upright and locked position.
5. Guide the two keyholes on the back of the console over the two screws.



Chapter 3

Using Your Weather Station

The console LCD screen and keyboard provide easy access to your weather information. The large LCD display shows current and past environmental conditions as well as a forecast of future conditions. The keyboard controls console functions for viewing current and historical weather information, setting and clearing alarms, changing stations types, viewing and/or changing station settings, setting up and viewing graphs, selecting sensors, getting the forecast, and so on.

Console Modes

The Vantage Pro2 console operates in five different modes:

Mode	Description
Setup	Use Setup Mode to enter the time, date, and other information required to calculate and display weather data.
Current Weather	Use Current Weather Mode to read the current weather information, change measurement units, and to set, clear or calibrate weather readings.
High/Low	High/Low Mode displays the daily, monthly or yearly high and low readings.
Alarm	Alarm Mode allows you to set, clear, and review alarm settings.
Graph	Graph Mode displays your weather data using over 100 different graphs.

Setup Mode

Setup Mode provides access to the station configuration settings that control how the station operates. Setup Mode consists of a series of screens for selecting console and weather station options. The screens that display in Setup Mode vary depending on the weather station type (cabled or wireless), or if the console has a WeatherLink connection already established. (See the *WeatherLink Getting Started Guide* for more information on connecting your console to your computer.)

Setup Mode Commands

Setup Mode displays when the console is first powered. This mode can be displayed at any time to change any of the console/weather station options. Use the following commands to enter, exit and navigate Setup Mode:

- Enter Setup Mode by pressing DONE and the - key at the same time.

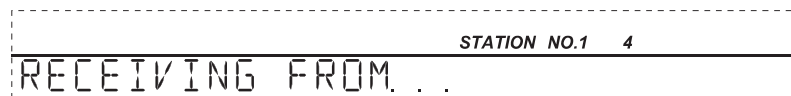
Note: The console automatically enters Setup Mode when first powered.

- Press DONE to move to the next screen in the Setup Mode.
- Press BAR to display the previous screen in the Setup Mode.
- Exit Setup Mode by pressing and holding DONE until the Current Weather screen displays.

Screen 1: Active Transmitters

Screen 1 displays the message “Receiving from...” and shows the transmitters being received by the console. In addition, an “X” blinks in the lower right-hand corner of the screen every time the console receives a data packet from a station. The rest of the LCD screen is blank.

If you have a cabled station, or if your wireless ISS uses the factory settings and you are receiving the signal, the screen displays “Receiving from station No. 1.” Any optional stations that have been installed should also display.



Screen 1: Active Transmitters

Note: An ISS or optional station must be powered for the console to recognize it. Refer to the *Integrated Sensor Suite Installation Manual* or optional station installation instructions for more information. It may take several minutes for the console to acquire and display a Transmitter ID.

1. Make a note of the station number(s) listed on the screen.

Note: If a Vantage Pro2 or Vantage Vue ISS has been installed in your area, its ID number may also be displayed.

2. Press DONE to move to the next screen.

The console can receive signals from up to eight transmitters total, but there is a limit on the number of certain types of transmitters. The table below lists the maximum number of stations allowable for a receiver:

Station Type	Maximum Number
Integrated Sensor Suite (ISS)	1
Anemometer Transmitter Kit (<i>replaces ISS anemometer</i>)	1
Leaf & Soil Moisture/Temperature Station	2*
Temperature Station	8
Temperature/Humidity Station	8

Maximum Number of Transmitters in a Network with One Receiver

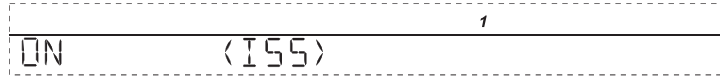
**Two are allowable only if both stations are only partially populated. For example, A network can either have both a Leaf Wetness/Temperature station and a Soil Moisture/Temperature station, or it can have one combined Leaf Wetness and Soil Moisture/Temperature station.*

Note: Listening to more than one transmitter may reduce battery life significantly.

Screen 2: Configuring Transmitter IDs — Wireless Only

(If you have a cabled station, press DONE and continue on to “Screen 4: Time & Date” on page 12.)

Setup screen 2 allows you to change the ISS transmitter ID and to add or remove optional transmitter stations. The default transmitter ID setting is “1” (ISS), which works fine for most installations.



Screen 2: Transmitter ID configuration

If you have a cabled station, or if you have a wireless station and are using the default transmitter ID setting, press DONE to move to the next screen.

Note: Typically, you can use the default transmitter ID setting of 1 unless you are installing one of the optional transmitter stations. However, if you are having trouble receiving your station, there may be another ISS with ID 1 operating nearby. Try changing the ID of both the console and ISS to another ID number.

3. Press the < and > keys to select the transmitter ID.
When you select a transmitter ID, the ID number is displayed on the screen as well as the current configuration.
4. Press the + and - keys to toggle console reception of signals from transmitters using that ID on and off.
5. Press GRAPH to change the type of station assigned to each transmitter. Scroll through the station types - ISS, TEMP, HUM, TEMP HUM, WIND, RAIN, LEAF, SOIL, and LEAF/SOIL - until the correct type appears.
6. Press DONE to move to the next screen.

Note: This screen contains functionality for enabling repeaters. If the word "Repeater" displays in the right corner of the screen and you are not using repeaters as part of your network, see "Clearing Repeater ID" on page 52. If you are using repeaters as part of your network see "Wireless Repeater Configuration" (Appendix C) on page 51 for configuring repeaters on the console.

Screen 3: Retransmit — Wireless Only

If you have a cabled station, press DONE and go to "Screen 4: Time & Date" on page 12.

The console can retransmit the data it receives from the ISS to other Vantage Pro2 or Vantage Vue consoles using the retransmit feature. By toggling the feature on, the console becomes another transmitter that requires its own unique ID to transmit the data received from the ISS.



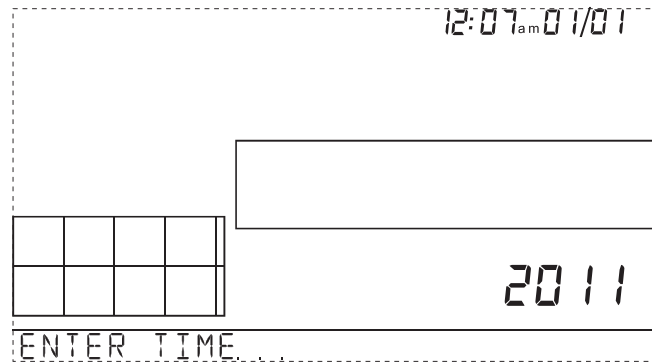
Screen 3: Retransmit

1. Press the + or - keys to turn the retransmit function on and off. The first available transmitter ID not used by the ISS or any optional sensor is automatically assigned. Data from the ISS is the only data that can be retransmitted by the console.
When retransmit has already been enabled, pressing the < and > keys changes the Transmitter ID used for retransmit.
2. Use the > key to scroll through the list of available transmitter IDs and select the ID for your console.
3. Press DONE to move to the next screen.

Note: Make a note of the ID selected for retransmit. The console that receives the data from the console you have selected to retransmit should be configured to receive the transmitter ID you selected. See “Screen 2: Configuring Transmitter IDs — Wireless Only” on page 10 for more information.

Screen 4: Time & Date

The first time you power-up the console, enter the correct date and local time.



Screen 4: Time & Date

To change the time and date:

1. Press the < and > keys to select the hour, minute, month, day or year. The selected time or date setting blinks on and off.
2. To change a setting, press the + and - keys to adjust the value up or down.
 To choose a 12-hour (default in US models) or 24-hour clock (default in EU and UK models), first select either the hour or minute setting, then press 2ND and immediately press UNITS. This toggles the clock setting between the two clock types.
 To choose between a MM/DD (default in US models) or DD.MM (default in EU and UK models) display for the date, first select either the day or month setting, then press 2ND and immediately press UNITS. This switches the console from one date display to the other.
3. Press DONE to move to the next screen.

Screen 5 and Screen 6: Latitude and Longitude

The console uses latitude and longitude to determine your location, allowing it to adjust the forecast and calculate the times for sunset and sunrise.

- Latitude measures distance north or south of the equator.
- Longitude measures distance east or west of the Prime Meridian, an imaginary line running north and south through Greenwich, England.

Note: You can find your latitude and longitude by searching the internet (for example: googlemaps.com, earth.google.com or earthtools.org). Many atlases and maps include latitude and longitude lines. You can also talk to the reference department of your local library, call your local airport, or search on the Internet.

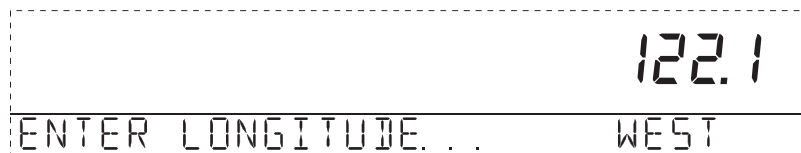
Setup Mode

The more accurate you are, the better; however, a reasonable estimate will work, too.



Screen 5: Latitude

1. Press the < and > keys to move between fields.
2. Press the + and - keys to change the settings up or down.
3. To select between SOUTH or NORTH, press 2ND and then UNITS.
4. Press DONE to move to the Longitude screen.



Screen 6: Longitude

1. Press the < and > keys to move between fields.
2. Press the + and - keys to change the settings up or down.
3. To select the East or West Hemisphere, press 2ND, then UNITS.
4. Press DONE to move to the next screen.

Screen 7: Time Zone

The console is pre-programmed with a combination of US time zones and the names of major cities representing time zones around the world. You can also configure your time zone using the Universal Time Coordinate (UTC) offset.



Screen 7: Time Zone

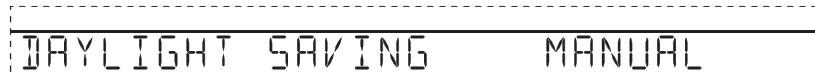
Note: UTC offset measures the difference between the time in any time zone and a standard time, set by convention as the time at the Royal Observatory in Greenwich, England. Hayward, California, the home of Davis Instruments, observes Pacific Standard Time. The UTC offset for Pacific Standard Time is -8:00, or eight hours behind Universal Time (UTC). When it's 7:00 pm (1900 hours) UTC, it's 19 - 8 = 1100 hours, or 11:00 am in Hayward in winter. When daylight saving time is observed, an hour is added to the offset time automatically. Use this function in correlation with Screen 8, Daylight Saving Settings.

1. Press the + and - keys to cycle through time zones.
2. If your time zone is not shown, press 2ND then press the + and - keys to set your UTC offset.
3. Press DONE to select the time zone or UTC offset shown on the screen and move to the next screen.

Screen 8: Daylight Saving Settings

In most of North America (except Saskatchewan, Arizona, Hawaii, and the Mexican State of Sonora); and Europe use the AUTO daylight saving setting. The console is pre-programmed to use the correct starting and stopping dates for daylight saving time in these areas, based on the time zone setting in screen 7.

Stations located outside North America and Europe, or in areas that do not observe daylight saving time should use the MANUAL setting.



Screen 8: Daylight Saving Settings

1. Press the + and - keys to choose Auto or Manual.
2. Press DONE to move to the next screen.

Screen 9: Daylight Saving Status

Use this screen to either verify the correct automatic daylight saving status or to set daylight saving manually.



Screen 9: Daylight Saving Status

1. If Daylight Saving setting is MANUAL, you will have to set the time correctly when it changes. However, to maintain accurate calculations, you also need to use the + and - keys to turn daylight saving time on or off on the appropriate days of the year. If you have an AUTO daylight saving setting, the console displays the appropriate setting based on the current time and date.
2. Press DONE to move to the next screen.

Screen 10: Elevation

Meteorologists standardize barometric pressure data to sea level so that surface readings are comparable, whether they're taken on a mountainside or by the ocean. To make this same standardization and ensure consistent readings, enter your elevation in this screen.



Screen 10: Elevation

Note: If you do not know your elevation, there are several ways to find out. Many atlases and almanacs include elevation for cities and towns. You can also check with the reference department of your local library, or refer to internet resources. (See "Screen 5 and Screen 6: Latitude and Longitude" for a list of web sites.) The more accurate you are, the better; but a reasonable estimate works too.

Setup Mode

1. Press the < and > keys to move from one numeral to another.
2. Press the + and - keys to adjust a numeral up or down.
3. To switch between feet and meters, press 2ND then press UNITS.
4. If you are below sea level, like in Death Valley or the Salton Sea, first enter the elevation as a positive number. Then, select the "0" immediately to the left of the left-most non-zero digit (the second zero from the left in 0026, for example, or the first zero from the left in 0207) and press the + and - keys to switch from a positive to negative elevation.

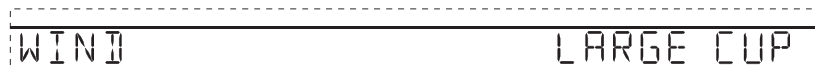
Note: You can only set the elevation to negative after you have entered a non-zero digit and when the zero in the position immediately to the left of the left-most non-zero digit has been selected.

5. Press DONE to move to the next screen.

Screen 11: Wind Cup Size

Vantage Pro2 stations come standard with large wind cups. Switch this setting to SMALL CUP if you have separately purchased and installed small wind cups. Switch to OTHER if you are receiving from a Vantage Vue ISS or are using a third-party anemometer.

Note: Large wind cups are more sensitive to low wind speeds and are the best choice for most users.

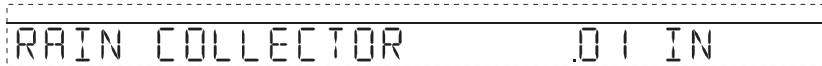


Screen 11: Wind Cup Size

1. Press the + and - keys to switch between the LARGE CUP, SMALL CUP, and OTHER wind cup settings.
2. Press DONE to move to the next screen.

Screen 12: Rain Collector

The tipping bucket in the Vantage Pro2 rain collector has been calibrated at the factory to measure 0.01" of rain with each tip for US models, or 0.2 mm of rain with each tip for UK and EU models. The typical user will not need to change this screen. However, some US users may want to install a metric adapter on their ISS so that it takes 0.2 mm readings for every tip of the bucket. If a metric adapter has been installed on your ISS, you should also calibrate your console for metric measurements using this screen.



Screen 12: Rain Collector Settings

Note: See the *Integrated Sensor Suite Installation Manual* for instructions on installing the metric rain adapter. The 0.1mm setting does not provide correct rain measurements with either the standard measurement or the metric adapter installed in the rain bucket and should not be used.

To calibrate your console for 0.2 mm measurements:

1. Press the + and - keys to display the 0.2 mm setting.
2. Press DONE to use the selected setting and move to the next screen.

If you calibrate your console for metric rain data in screen 12 of the Setup Mode, you will also need to set up your Current Weather Mode to display the metric readings. To display metric rain readings in the Current Weather Mode, once you have completed or exited the Setup Mode:

To Display Rain in Metric Units on the Console

1. Press RAIN_{VR} to display the current rain rate.

Selecting Metric units for one rain variable also sets all the other rain variables to Metric units.

2. Press and release 2ND and press UNITS once.

The units used to display rain data toggle between inches and millimeters each time you repeat this key sequence.



To Display Rain in Metric Units in WeatherLink

Refer to the *WeatherLink Online Help* for instructions to set the rain collector to 0.2 mm and to select millimeters as the unit for rain.

Screen 13: Rain Season

Because rainy seasons begin and end at different times in different parts of the world, you must specify the month you wish your yearly rain data to begin. January 1st is the default. The date the rain season begins affects yearly rain rate highs and lows.



Screen 13: Rain Season

1. Press the + and - keys to select the month for the start of the rainy season.
2. Press DONE to move to the next screen.

Note: This setting determines when the yearly rain total is reset to zero. Davis Instruments recommends a January rain season setting (the default), unless you reside in the west coast of the United States, the Mediterranean coast, experience dry winters in the Southern Hemisphere. If so, change the rain season setting to July 1st. If you are performing hydrology studies in any of these climates in the Northern Hemisphere, change the rain season setting to October 1st.

Screen 14: Serial Baud Rate

The Baud Rate screen displays only if the console detects that a WeatherLink data logger installed on the console.

The console uses a serial or USB port to communicate with a computer. If you are connecting the console directly to your computer via USB or Ethernet, leave the setting at 19200, the highest rate for the port. If you're using a modem, use the highest setting your modem can handle. The console must be equipped with a WeatherLink data logger to communicate with a computer or modem.



Screen 14: Baud Rate

Note: The baud rate setting on your console must match the baud rate of the software you are using. If you are using WeatherLink for Vantage Pro2, refer to WeatherLink help for instructions on setting the serial port baud rate on your computer.

1. Press the + and - keys to select the baud rate.
Your Vantage Pro2 console supports baud rates of 1200, 2400, 4800, 9600, 14400, and 19200.
2. You have completed the console setup. To exit Setup Mode, press and hold DONE until the current weather screen appears.

Clear All Command

After you have completed the above setup procedures and have exited the Setup Mode, please use the Clear All command before putting your weather station into service.

The Clear All command clears all stored high and low weather data including monthly and yearly highs and lows and clears the alarm settings. The command is recommended to properly clear the console of any erroneous data before first putting the station into use.

1. Press WIND on the console.
2. Press 2ND, then press and hold CLEAR for at least six seconds.
3. Release CLEAR when you see "CLEARING NOW" displayed at the bottom of the console's screen.

Current Weather Mode

In the Current Weather Mode you can display the current data readings from your station, select units of measure, and calibrate, set, or clear weather variables. You can see up to ten weather variables on the screen at the same time, as well as the time and date, the moon and forecast icons, a forecast or special message from your station, and a graph of the currently selected variable. A few variables are always visible on the console screen while most variables share their location with one or more variables. You can select any variable not currently on the screen to display it.

Selecting Weather Variables

Select a weather variable to display its data on the screen if it isn't already visible or to graph the data available for that variable.

Weather variables are selected via the console command keys:

- If the variable is printed on a key, just press the key to select the variable.
- If the variable is printed on the console housing, first press and release 2ND, then quickly press the key below the variable to select it.



Note: After pressing 2ND, the 2ND icon displays on the screen for three seconds. Command key secondary functions are enabled during this time. The keys return to normal operation after the icon disappears.

- Select a variable and press GRAPH to graph the variable in the Current Weather Mode screen. The console places a graph icon on the screen next to the selected variable or value you want to view to indicate the currently selected variable.
- You can also select any variable currently displayed on the LCD screen using the navigation keys. Push up (+) to move up the screen. Press down (-) to move down the screen. Push left (<) to move left and push right (>) to move right.



Selecting Units of Measure

Most weather variables may be displayed in at least two different measurement units, including imperial (US) and metric systems, although some variables feature more possibilities. Barometric pressure, for example, may be displayed in millibars, millimeters, inches, or hectoPascals. Note that you can set each variable's units independently, and at any time, as you like.

To change units:

1. Select the weather variable. See "Selecting Weather Variables" on page 18.
2. Press and release 2ND then press UNITS. The selected variable's units change. Repeat steps 1 and 2 until the desired units appear.



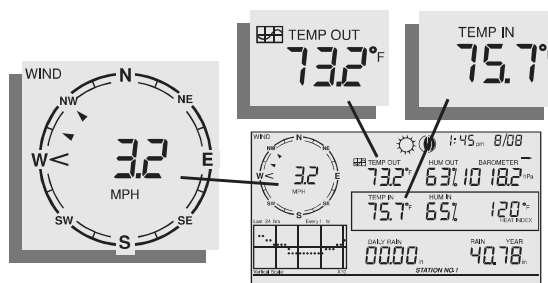
For example, to change the barometric pressure units, first select barometric pressure by pressing BAR. Next, press and release 2ND, then press UNITS. Repeating

Selecting Units of Measure

these steps cycles through the units available for barometric pressure: millibars, millimeters, inches, and hectoPascals.



Displaying Units: Barometric Pressure Units: millibars (mb), millimeters (mm) and



Wind Direction, Outside and Inside Temperature

Wind Speed and Direction

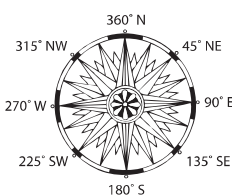
Press WIND to select wind speed.

3. Wind speed may be displayed in miles per hour (m.p.h.), kilometers per hour (km/h), meters per second (m/s), and knots (knots). The 10 minute average wind speed will be displayed in the ticker.

A solid arrow within the compass rose indicates the current wind direction. Arrow caps indicate up to six different 10-minute dominant wind directions to provide a history of the dominant wind directions for the past hour.

4. Press WIND a second time to display the wind direction in degrees instead of the wind speed. When displayed in degrees, Due North displays as 360° for consoles with firmware dated May 2005 or later. Previous releases marked Due North at 0°.

Each additional WIND key press toggles the display between wind speed and wind direction in degrees.



Note: If your anemometer arm is not pointing true north, you should recalibrate the wind direction reading on your console. See "Calibrate Wind Direction Reading" on page 25 for more information.

Outside and Inside Temperature

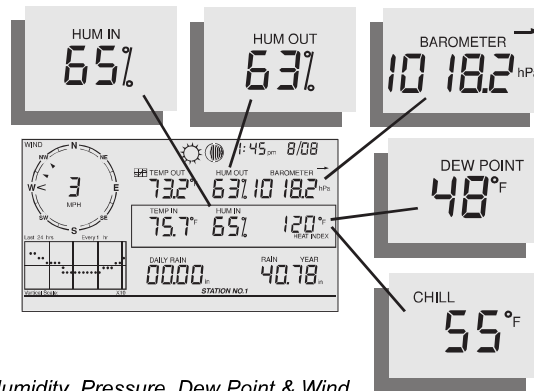
1. Press TEMP to select outside temperature.

Temperature may be displayed in degrees Fahrenheit (°F) or Celsius (°C). Temperatures can also be displayed in degrees or in tenths of a degree.

TEMP

2. Press TEMP again to select inside temperature.

Each consecutive press of TEMP displays temperature readings for any optional temperature, temperature/humidity, soil temperature, soil moisture stations also connected to your console. The order of the optional sensors readings display depends on your station configuration. Temperatures for temperature stations display, with soil temperature and moisture stations displaying consecutively.



Humidity, Pressure, Dew Point & Wind

Humidity

DEW HUM

Press HUM to select outside humidity. Pressing HUM a second time selects inside humidity. Humidity is displayed in percent relative humidity. Each consecutive press of HUM displays humidity readings for any optional humidity, leaf wetness, and leaf temperature stations also connected to your console. The order of the optional sensors readings display depends on your station configuration. Humidity readings for humidity stations display, with leaf wetness and leaf temperature readings displaying consecutively.

Wind Chill

Press 2ND then press CHILL to select Wind Chill. Wind Chill is displayed in either Fahrenheit (°F) or Celsius (°C) in whole degrees.

2ND CHILL WIND

The console uses the ten-minute average wind speed to calculate wind chill.

Dew Point

Press 2ND then press DEW to select Dew Point. Dew Point is displayed in either Fahrenheit (°F) or Celsius (°C) in whole degrees.

2ND DEW HUM

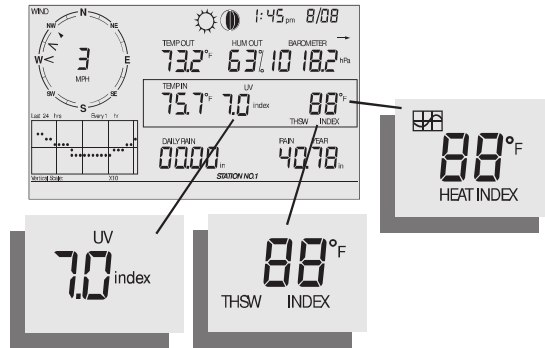
Barometric Pressure

BAR

Press BAR to select barometric pressure. Barometric pressure may be displayed in inches (in), millimeters (mm), millibars (mb) or hectoPascals (hPa).

Pressure Trend

The pressure trend arrow indicates the current barometric trend, measured over the last three hours. The pressure trend is updated every 15 minutes. The pressure trend requires three hours of data in order to be calculated so it won't display right away on a new station. The pressure trend is indicated on the console screen, as long as the required data is available.



UV, Heat, and THSW Index

UV (Ultraviolet Radiation)

Press 2ND and UV to display the current UV index. The current UV index is the amount of ultraviolet radiation the sensor is currently reading.



Press 2ND and UV again to display the accumulated UV index for the day. The accumulated UV index is the total ultraviolet radiation that the sensor has read throughout the day. The accumulated UV index for the day is reset to zero every night.

Note: Requires a UV sensor. See "Optional Sensors & Transmitting Stations" on page 2.

Heat Index

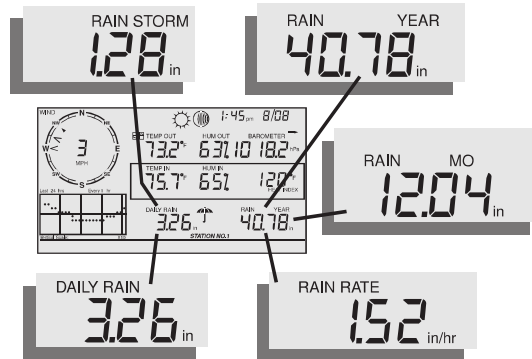
Press 2ND then press HEAT to display the Heat Index.



THSW Index

After you have selected the Heat Index, press 2ND then press HEAT again to select the Temperature Humidity Sun Wind (THSW) Index. The THSW Index is only available on stations equipped with a solar radiation sensor.

The Heat Index and the THSW Index display in the same place on the screen and are displayed in degrees Fahrenheit (°F) or Celsius (°C).



Daily Rain, Rain Storm, Rain Year, Rain Month, & Rain Rate

Rain Rate

Press RAINYR to display the current rain rate. Rain Rate may be displayed as either inches per hour (in/hr.) or millimeters per hour (mm/hr.). Rain Rate will show zero and the umbrella icon does not appear until two tips of the rain bucket within a 15-minute period.



Month-to-date precipitation

Press RAINYR again to select the month-to-date precipitation record. Monthly rain displays the precipitation accumulated since the calendar month began. Month-to-date precipitation is displayed in inches or millimeters (mm).

Year-to-date precipitation

Press RAINYR a third time to display the year-to-date precipitation record. Yearly rain displays the precipitation accumulated since the 1st of the month you've chosen as the beginning of your rain season in Setup Mode (See "Screen 13: Rain Season" on page 16). Year-to-date precipitation is displayed in inches (in) or millimeters (mm).

Daily Rain

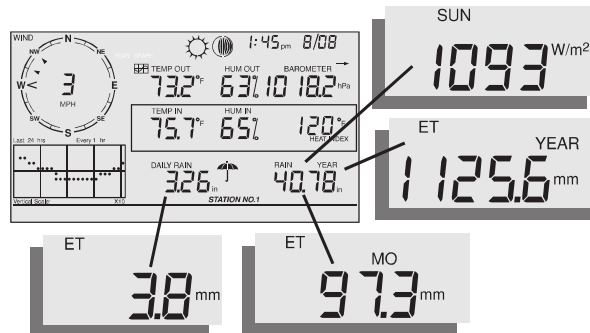
Press RAINDAY to display the rain accumulated since 12 midnight. Any rain accumulated in the last 24 hours displays in the ticker at the bottom of the screen.



Rain Storm

Rain Storm displays the rain total of the last rain event. It takes two tips of the rain bucket to begin a storm event and 24 hours without rain to end a storm event.

Press RAINDAY to toggle between the daily rain total and the Rain Storm total. Rain accumulation may be displayed as either millimeters (mm) or inches (in).



Solar Radiation, Current ET, ET Month & ET Year

Solar Radiation

Press and release 2ND then press SOLAR to display the current solar radiation reading. Solar radiation is displayed as Watts per square meter (W/m^2).



Current Evapotranspiration (ET)

Press and release 2ND then press ET to display the current evapotranspiration reading.



Monthly Evapotranspiration (ET)

Press 2ND then press ET, then repeat the key sequence to display Monthly ET.

Yearly Evapotranspiration (ET)

Press 2ND then press ET, then repeat this key sequence two more times to display the ET reading since January 1st of the current year.

Note: A solar radiation sensor is required to take readings listed above. See "Optional Sensors & Transmitting Stations" on page 2.

Lamps

Press 2ND then press LAMPS to turn on the backlight for the screen display. Press 2ND then LAMPS again to turn the backlight off.

Use the backlight when the LCD is not clearly visible. When the console is battery operated, the backlight remains on as long as keys are pressed or a ticker tape message is scrolling across the screen. If no keys are pressed, the backlight automatically turns off about fifteen seconds after it is turned on. If any key is pressed while it is turned on, it will stay illuminated for 60 seconds from the last key press. When battery power is low, the backlight does not light.



Note: When the console receives power from the AC adapter, the backlight remains on until it is toggled off. Leaving the backlight on raises the inside temperature reading and lowers the inside humidity reading.

Displaying the Forecast

Your console generates a weather forecast based on the barometric reading & trend, wind speed & direction, rainfall, temperature, humidity, latitude & longitude, and time of year. Included in the forecast is a prediction of the sky condition (sunny, cloudy, etc.) and changes in precipitation, temperature, wind direction or wind speed.

Press FORECAST to display the forecast. The forecast ticker message at the bottom of the screen predicts the weather up to 48 hours in advance. The forecast is updated once an hour, on the hour. Predictions are made for cloud cover, temperature trends, the likelihood of precipitation, timing, severity and windy conditions.

FORECAST

Forecast Icons

The forecast icons show the predicted weather for the next 12 hours. If rain and/or snow is possible but not necessarily likely, the partly cloudy icon along with the rain or snow icon displays. When both the rain and snow icons display together, a chance of rain, freezing rain, sleet and/or snow is likely.



Displaying Time & Date or Sunrise & Sunset

Your console shows the sunrise and sunset time in the same place on the screen used by the current time and date. Press 2ND and then press TIME to toggle the screen between the current time and date or the sunrise and sunset times for the current day.

Note: See "Screen 4: Time & Date" on page 12 to change the console time and date or to select a 12- or 24-hour clock.

Calibrating, Setting, and Clearing Variables

To fine-tune your station, you can calibrate most of the weather variables. For example, if your outside temperature seems consistently too high or too low, you can enter an offset to correct the deviation.

Calibrating Temperature And Humidity

You can calibrate inside & outside temperature, inside & outside humidity, as well as any extra temperature/humidity sensor readings you have transmitting to your Vantage Pro2.

1. Select a variable to be calibrated. See “Selecting Weather Variables” on page 18.
2. Press and release 2ND, then press and hold SET.

After a moment, the variable you’ve selected begins to blink.

Keep holding SET until the Calibration Offset message displays in the ticker.

The ticker displays the current calibration offset.

3. Press the + and - keys to add or subtract from the temperature offset value.

Inside and outside temperature are calibrated in 0.1° F or 0.1° C increments, up to a maximum offset of +12.7 (°F or °C) and a minimum offset of -12.8 (°F or °C). The variable will change value and the ticker will show the offset you’ve entered.

4. Press DONE to exit calibration.



Calibrate Wind Direction Reading

If the anemometer arm cannot be mounted pointing to true north, use this procedure to correct the wind direction console reading.

1. Check the current direction of the wind vane on the anemometer. Compare it to the wind direction reading on the console.
2. Press WIND as necessary to display the wind direction in degrees.
3. Press and release 2ND, then press and hold SET.
4. The wind direction variable will begin to blink.
5. Continue holding the key until the CAL message appears in the ticker. The ticker displays the current wind direction calibration value.
6. Press the < and > keys to select digits in the anemometer’s current reading.
7. Press the + and - keys to add/subtract from the anemometer reading.
8. Repeat steps 6 and 7 until you have entered the offset value from Step 1.
9. Press DONE to exit calibration.

Calibrating Barometric Pressure

Before calibrating the barometric pressure, be sure the station is set to the correct elevation. See “Screen 10: Elevation” on page 14 for more information.

1. Press BAR to select barometric pressure.
2. Press and release 2ND, then press and hold SET.

The pressure variable blinks.

3. Continue holding the key until the ticker reads “set barometer . . .”.
4. Press the < and > keys to select digits in the variable.
5. Press + and - keys to add to or subtract from the digit’s value.

6. Press DONE to exit calibration.

Setting Weather Variables

You can set values for the following weather variables:

- **Daily Rain**—Sets the daily rain total. Monthly and yearly rain totals are updated.
- **Monthly Rain**—Sets the current months total rain. Does not affect yearly rain total.
- **Yearly Rain**—Sets the current year's rain total.
- **Daily ET (Evapotranspiration)**—Sets the daily ET total. Monthly and yearly ET totals are updated.
- **Monthly ET**—Sets the current month's ET. Does not affect yearly total.
- **Yearly ET**—Sets the current year's total ET.

To set a weather variable's value:

1. Select the variable you wish to change.
2. Press and release 2ND, then press and hold SET. The variable blinks.
3. Keep holding SET until all digits are lit and only one digit is blinking.
4. Press the < or > keys to select digits in the value.
5. Press the + and - keys to add to or subtract from the selected digit.
6. When you are finished, press DONE to exit.

Clearing Weather Variables

The following weather variables can be cleared:

- **Barometer**—Clears any pressure offset used to calibrate the station, and the elevation entry.
- **Wind**—Clears the wind direction calibration.
- **Daily rain**—Clearing the daily rain value is reflected in the daily rain total, the last 15 minutes of rain, the last three hours of rain sent to the forecast algorithm, the umbrella icon, and the monthly and yearly rain totals. Clear the daily rain total if the station accidentally recorded rain when the ISS was installed.
- **Monthly rain**—Clears the monthly rain total. Does not affect the yearly rain total.
- **Yearly rain**—Clears the yearly rain total.
- **Daily ET**—Clears daily ET and subtracts the old daily ET total from the monthly and yearly ET totals.
- **Monthly ET**—Clears the current monthly ET total. Does not affect the yearly ET total.
- **Yearly ET**—Clears the current yearly ET total.

To clear a single weather variable:

1. Select the weather variable.
See "Selecting Weather Variables" on page 18.
2. Press and release 2ND, then press and hold CLEAR.
The variable you've chosen blinks. Keep holding the key until the value changes to zero or, in the case of the barometer, the raw barometer value. Clearing the barometer value also clears the elevation setting.

Clear All Command

This command clears all stored high and low weather data including monthly and yearly highs and lows and clears alarm settings all at once.

1. Press WIND on the console.

Highs and Lows Mode

2. Press 2ND then press and hold CLEAR for at least six seconds.
3. Release CLEAR when “CLEARING NOW” displays at the bottom of the console’s screen.

Highs and Lows Mode

The Vantage Pro2 records highs and lows for many weather conditions over three different periods: days, months, and years. Except for Yearly Rainfall, all high and low registers are cleared automatically at the end of each period.

For example, daily highs are cleared at midnight, monthly highs are cleared at month-end midnight, yearly highs are cleared at year-end midnight. You may enter the month that you would like the Yearly Rainfall accumulation to clear. The Yearly Rainfall clears on the first day of the month you chosen. The Yearly High Rain rate clears using the same setting.

The following table lists the high and low modes for all the weather variables:

Weather Variable	High	Low	Day, Time & Date	Month	Year	Additional Information
Outside Temperature	Yes	Yes	Yes	Yes	Yes	
Inside Temperature	Yes	Yes	Yes	Yes	Yes*	
Outside Humidity	Yes	Yes	Yes	Yes	Yes*	
Inside Humidity	Yes	Yes	Yes	Yes	Yes*	
Barometer	Yes	Yes	Yes	Yes	Yes*	
Heat Index	Yes		Yes	Yes	Yes*	
Temp/Hum/Wind/Sun (THSW) Index	Yes		Yes	Yes	Yes*	requires solar radiation sensor
Wind Chill		Yes	Yes	Yes	Yes*	
Wind Speed	Yes		Yes	Yes	Yes	Includes direction
Rainfall Rate	Yes		Yes	Yes	Yes	
Daily Rain			Total	Total	Total	
UV Index	Yes		Yes	Yes**	Yes*	requires UV sensor
Solar Radiation	Yes		Yes	Yes**	Yes*	requires solar radiation sensor
Dew Point	Yes	Yes	Yes	Yes	Yes*	
Evapotranspiration			Total	Total	Total	requires solar radiation sensor
Soil Moisture	Yes	Yes	Yes	Yes**	Yes*	requires soil moisture sensor
Leaf Wetness	Yes	Yes	Yes	No	Yes*	requires leaf wetness sensor

* Only stores the yearly high for the current year.

** Only stores monthly high for the current month.

Weather Data Highs and Lows

Viewing Highs and Lows

1. Press HI/LOW to enter the Highs and Lows mode.

The DAY and HIGHS icons light up and the station displays the highs for all visible fields.

2. Press the + and - keys to scroll between Day Highs, Day Lows, Month Highs, Month Lows, Year Highs and Year Lows.

The HIGH or LOW icon, as well the DAY, MONTH or YEAR icon lights to display which High/Low screen you've selected.

3. Press the < and > keys to scroll back and forth through the last 24 values.

Pressing the < key displays the previous day's highs. Each time you press the < key, the date moves back another day. The 24 dots in the graph field also represent each of the last 24 days, months, or years; the right-most dot is the present. As you move backward and forward the flashing dot changes to show what value you're looking at.

4. Use the console keys to select a different weather variable.

The console's time displays time of the selected variable's high or low.

5. Press DONE to exit the Highs and Lows mode. The console screen switches to the Current Weather mode.

Alarm Mode

The Vantage Pro2 features more than 30 alarms that can be programmed to sound whenever a reading exceeds or drops below a set value. With the exception of barometric pressure and time, all alarms sound when a reading reaches the alarm threshold. For example, if the high outside temperature alarm is set at 65° F, the alarm sounds when the temperature rises to 65.0° F.

When an alarm condition exists, the audible alarm sounds, the alarm icon blinks repeatedly, and an alarm description appears in the ticker at the bottom of the screen. The alarm sounds for a maximum of two minutes if the console is battery-powered, but the icon continues to blink and the message stays in the ticker until you clear the alarm or the condition clears. If you're using the AC adapter, the alarm will continue sounding as long as the condition exists.

The alarm will sound again for each new alarm. If more than one alarm is active, the description for each active alarm cycles onto the screen every four seconds. A "+" symbol appears at the end of the alarm text if more than one alarm is tripped.

Low alarms work the same way. For example, if the wind chill threshold is set for 30°F, the alarm condition begins when the wind chill drops to 30° and will continue until the wind chill rises above 30°.

Four Special Alarms

ET (Evapotranspiration)

ET is updated only once an hour, on the hour. If during a given hour the ET Value exceeds the alarm threshold, the ET alarm sounds at the end of that hour. This is true for daily, monthly, and yearly ET alarms. You must have the optional Solar Radiation Sensor to use this alarm. See "Evapotranspiration (ET)" on page 46. for a description of this variable.

Barometric Pressure

The Vantage Pro2 allows you to set two barometric pressure alarms: a "rise" alarm and a "fall" alarm. You may select any rate of change per three hours between 0.00 and 0.25 inches (6.35 mm) Hg, (8.5 mb, hPa); the alarm will sound if the rate of change (in either direction) exceeds the threshold you set. This alarm is updated every 15 minutes.

Time

The time alarm is a standard "alarm clock" alarm. It sounds for one minute at the set time. Make sure you choose AM or PM, if you're in 12-hour mode.

UV Dose

The UV dose alarm sounds when the accumulated UV dose has exceeded the dose you set. The UV dose alarm does not arm unless the initial UV dose for the day has been reset. Once the UV dose alarm value is set, clear the accumulated UV dose. See “Clearing Weather Variables” on page 26.

Setting Alarms

1. Press ALARM to enter the Alarm Mode to view or set the high alarm thresholds.
The screen displays the current high alarm thresholds. The ALARM and HIGHS icons also appear.
2. Press the < and > keys to select one of the variables displayed on the screen or use the console keys to select any weather variable. Also, press HI/LOW to display the toggle between the high and low alarm threshold settings.
3. Press 2ND then press ALARM to activate the currently selected weather variable.
4. Press the < and > keys to select digits in the threshold value.
5. Press the + and - keys to change the digit's value up and down.
6. Press DONE to finish changing the alarm setting.
7. Repeat steps 3 through 6 to change additional alarm settings.
8. Press DONE to exit Alarm Mode.

Vantage Pro2 Station Alarms

Variable	Alarms
Barometric Pressure Trend	Storm Warning - uses trend value falling rate Storm Clearing - uses trend value rising rate
Evapotranspiration	ET Alarm - uses total ET for the day
Humidity, Inside	High and Low
Humidity, Outside	High and Low
Dew Point	High and Low
Leaf Wetness	High and Low
Rain	Flash Flood Alarm - uses current 15 minute rainfall total 24 Hour Rain Alarm - uses current 24 hour rainfall total
Storm	Storm Alarm - uses current storm rainfall total
Rain Rate	High
Soil Moisture	High and Low
Solar Radiation	High
Inside Temperature	High and Low
Outside Temperature	High and Low
Extra Temperature	High and Low
Heat Index Temperature	High
THSW Index Temperature	High
Wind Chill Temperature	Low
UV Radiation Index	High
UV Radiation MED	High - uses the current total if variable has been reset
Wind Speed	High
Time & Date	Yes - the alarm sounds for 1 minute.

Setting the Time Alarm

1. Press ALARM to enter alarm mode.
The ALARM and HIGHS icons appear.
2. Press 2ND, then press TIME, then press 2ND again, and then press ALARM.
The time field begins blinking.
3. Press the < and > keys to select hours, minutes, or AM/PM.
4. Press + and - keys to change the digit's value up and down.
5. Press DONE to exit Alarm Mode.

Clearing Alarm Settings

1. Press ALARM to enter alarm mode.
The ALARM and HIGHS icons appear.
2. Select the alarm setting you wish to clear.
3. Press 2ND, then press and hold CLEAR until the setting changes to all dashes.
You have cleared the alarm setting.
4. Press DONE to exit Alarm Mode.

Note: To clear **all** alarms, enter Alarm mode (press and release the ALARM key), then press and hold the ALARM key until all the fields become dashed.

Silencing Alarms

1. Press DONE to silence an alarm when it sounds.

Graph Mode

The Vantage Pro2 console includes a powerful Graph Mode that allows you to view over 100 graphs of different kinds right on the screen, all without connecting to a personal computer.

Viewing Graphs

Although the graphs available may vary for each weather variable, you display the graphs in the same way.

1. Select a variable to graph.

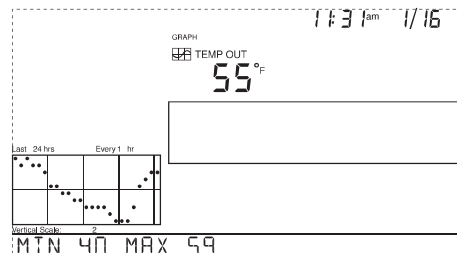
Only the date, graph, graph icon, and selected variable are visible.
The rest of the screen is blank.

2. Press GRAPH to enter Graph Mode.

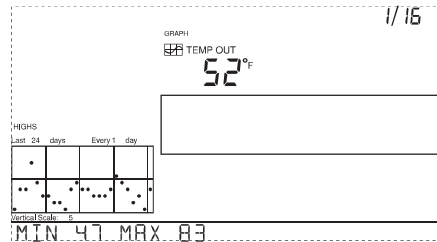
Values for the each of the last 24 hours are displayed in the graph, each hour represented by a dot.

The dot at right end of the graph is the value for the current hour. You'll notice that the dot is blinking.

3. Press the < key and the second dot from the right starts to blink.
The screen displays the new dot's value. The time display shows what hour of the last 24 is being viewed.
4. Press the < and > keys to view the variable's values for each of the last 24 hours. The console also displays the maximum and minimum temperatures recorded in the last 24 hours.
5. Press the + and - keys to shift the graph's time span.



If you press the - key the graph shifts from the last 24 hours to the last 24 days. Now each dot represents the high recorded on the day shown in the date field. To see the lows recorded in the last 24 days, press HI/LOW. Press the < and > keys to move between days.



By pressing the - key again, the graph shifts to show the highs of the last 24 months. As before, use the < and > keys to move between months. Press HI/LOW to shift between the highs and lows.

By pressing the - key again, the graph shifts one more time to show the highs of the last 24 years. Press HI/LOW to shift between highs and lows.

The console beeps when you've reached the first or last possible value or time span for the graph. Since the console only graphs data collected by the station, the graphs can only show data collected since the station was first installed.

View graphs of all other variables the same way.

1. Select the variable you want to view.
2. Press GRAPH.
3. Use the < and > keys to select different variables.
4. Press the + key to shorten the time range.
5. Press the - key to lengthen the time range.
6. Press HI/LOW to shift between highs and lows.
7. Press DONE to exit.

Graph Mode

Vantage Pro2 Console Graphs

Weather Variable	Available Graphs*							
	Current	1 Min	10 Min	15 Min	Hourly	Daily	Monthly	Yearly
Barometric Pressure	C	C			C	H, L	H, L	
Evapotranspiration (ET)**	T				T	T	T	T
Humidity, Inside	C				C	H, L	H, L	
Humidity, Outside	C				C	H, L	H, L	
Dew Point	C				C	H, L	H, L	
Leaf Wetness***	C				C	H, L		
Rain	T			T	T	T	T	T
Storm****								
Rain Rate	H	H			H	H	H	H
Soil Moisture	C				C	H, L		
Solar Radiation**	A				A	H		
Inside Temperature	C				C	H, L	H, L	
Outside Temperature	C				C	H, L	H, L	H, L
Heat Index Temperature	C				C	H	H	
Temp/Hum/Sun/Wind (THSW) Index**	C				C	H	H	
Wind Chill Temperature	L				L	L	L	
UV Radiation Index*****	A				A	H	C	
UV Radiation MED (Minimal Erythermal Dose)*****	T				T	T		
Wind Speed	A		A		A, H	H	H	H
Direction of High Wind Speed	Y					Y	Y	Y
Dominant Wind Direction	A				A	A	A	

* A = Average, H = Highs, L = Lows, T = Totals, Y = Yes, C = Current reading at the end of each period

** Requires solar radiation sensor, *****Requires UV sensor

*** Requires Wireless Leaf & Soil Moisture Temperature station

**** Graphs the last 24 storm events and doesn't follow the same graph conventions as other variables.

Chapter 4

Troubleshooting and Maintenance

Vantage Pro2 Troubleshooting Guide

While your Vantage Pro2 weather station is designed to provide years of trouble-free operation, occasional problems may arise. If you are having a problem with your station, please consult this troubleshooting guide before calling Davis technical support. You may be able to quickly solve the problem yourself. Please see “Contacting Davis Technical Support” on page 53.

Note: Refer to the ISS Installation Manual for additional troubleshooting information.

TABLE 4-1: TROUBLESHOOTING GUIDE

	Problem	Solution
Display	Display shows only “RECEIVING FROM.....”	Indicates that console has rebooted. Hold the DONE key to return to Current Weather Mode. (Check time setting if power was lost.)
	Display is blank	Unit is not receiving power. Check the power adapter connections and/or replace batteries.
	Display shows dashes in place of weather data	<ul style="list-style-type: none"> ISS not plugged in (cabled station). See ISS manual. Sensors not transmitting (wireless station). See ISS (or other transmitter) manual. Console not receiving (wireless station) - See “Troubleshooting Reception Problems” on page 35. A reading has exceeded the limits indicated in the specifications table. Calibration numbers may be causing readings to exceed display limits. Check calibration number and adjust if necessary.
	Console is sluggish or does not work at low temperatures	The console and display may not work below 32° F (0° C). Use an External Temperature sensor in low-temperature locations or install the console indoors.
	Display “locks up”	Reset the console by removing AC and battery power then restoring power. If this occurs frequently in an AC-powered console, plug the AC power-adaptor into a surge suppressor.
Humidity	Inside humidity seems too high or too low	Make sure the console is not near a humidifier or de-humidifier. Check calibration number and adjust if necessary. If inside humidity is low, and inside temperature is too high, see “inside temp” below. Also make sure the console backlight is not on.
Wind Speed	Wind speed reading seems too high or too low.	For low readings, remove wind cups and check for friction sources. Check the anemometer location. Is it sheltered from the wind? See ISS manual for additional wind speed troubleshooting information.
	Wind speed reads 0 either all the time or intermittently	The problem may be with the anemometer. Test anemometer by spinning wind cups. Check reed switch fields on diagnostic screen (see page 37) and call technical support.
Dew	Dew Point reading seems too high or too low	Check calibration numbers for temperature. Dew point depends on temperature and outside humidity. Make sure they’re working.

TABLE 4-1: TROUBLESHOOTING GUIDE

	Problem	Solution
Temperature	Outside temperature sensor reading seems too high	Check to see if ISS is near mechanical or radiant heat source. Check calibration number and adjust if necessary. ISS or temp sensor may need to be relocated. See ISS or other transmitter manual.
	Inside temperature sensor reading seems too high	Move the console out of direct sunlight. Make sure that the console or sensor is not in contact with an exterior wall that heats up in sunlight or when outside temperature rises. Make sure the console or sensor is not near a heater or other internal heat source (lamps, appliances, etc.). Also make sure the console backlight is not on. Check calibration number and adjust if necessary.
	Outside temperature seems too low	Check calibration number and adjust if necessary. Sprinklers may be hitting the ISS radiation shield. Relocate. See ISS manual.
	Inside temperature sensor reading seems too low	Make sure the console or other temperature sensor is not in contact with an exterior wall that cools down when outside temperature drops. Make sure the console or other temperature sensor is not near an air conditioning vent. Check calibration number and adjust if necessary.
Wind Direction	Wind direction reading is dashed out	<ul style="list-style-type: none"> Wireless model - check reception. See Reception Problems below. Cabled model - cable may be faulty. If these steps do not reveal the problem, the anemometer may be faulty. Call technical support.
	Wind direction always says north	Usually a problem in the ISS, either with the transmitter or anemometer cable. See the ISS manual for troubleshooting information.
Chill	Wind chill reading seems too high or too low	Check calibration numbers for temperature. Wind chill depends on temperature and wind speed. Make sure they're working.
Heat	Heat Index reading seems too high or too low	Check calibration numbers for temperature. The heat index depends on temperature and outside humidity. Make sure the sensors are working.
Rain	No rain readings	Make sure cable-tie is removed from inside the rain collector. See the ISS manual.
UV/Solar	Readings are too high	Can be caused by high thin cirrus clouds.
Time	Incorrect times for sunrise and sunset	Check your latitude, longitude, time zone, and daylight savings time settings. Sunrise and sunset times are calculated from the console using all of these settings.

Troubleshooting Reception Problems

While we have tested the Wireless Vantage Pro2 radio extensively, each site and each installation presents its own issues and challenges. Obstructions, particularly metallic ones, often cut down your station's reception distance. Be sure to test reception between the console and ISS, in the locations you intend to install them, before permanently mounting your ISS or other transmitter(s).

The console's reception status displays at the lower right corner of the screen.

- An “X” flashes for every data packet received by the console.
- An “R” displays when the console is trying to re-establish a lost connection. The console tries for 10 minutes to re-establish a connection before going into L Mode. When no data packets have been received for 10 minutes, the console dashes-out any missing sensor readings.
- An “L” displays when the signal is lost (and the console is “asleep.”) The console stays in this mode for 15 minutes until returned to “R” mode. To force the console into “R” mode (“wake up” the console), enter and exit Setup Mode.

Check Console Reception

Enter Setup mode by pressing and holding DONE, then pressing the - key at the same time. Wait a few minutes while the console lists all the stations transmitting within range (See “Screen 1: Active Transmitters” on page 10 for more information). If the console does not detect your transmitter, check the following:

- Adjust the console and ISS antennas so that they are in line of sight with each other.
- Reduce the distance between the ISS and the console.
- If the console is directly beneath the ISS, the antennas should be horizontal.
- Try distancing your console from your ISS, at least 10 feet apart.
- Change the Transmitter ID (on both the console and the ISS) to a number other than 1.

Refer to the *ISS Installation Manual* or other station manual for instructions on how to check the station for potential transmission problems.

Console Diagnostic Mode

In addition to logging weather data, the console continuously monitors the station’s radio reception. You may find this information very helpful, especially when you are choosing locations for your console and ISS.

The Console Diagnostics Mode consists of two screens, the Statistical Diagnostic Screen and the Reception Diagnostic Screen. The Statistical Diagnostic screen applies for both cabled and wireless weather stations. The Reception Diagnostic screen applies only to wireless weather stations and is not accessible to a cabled weather station.

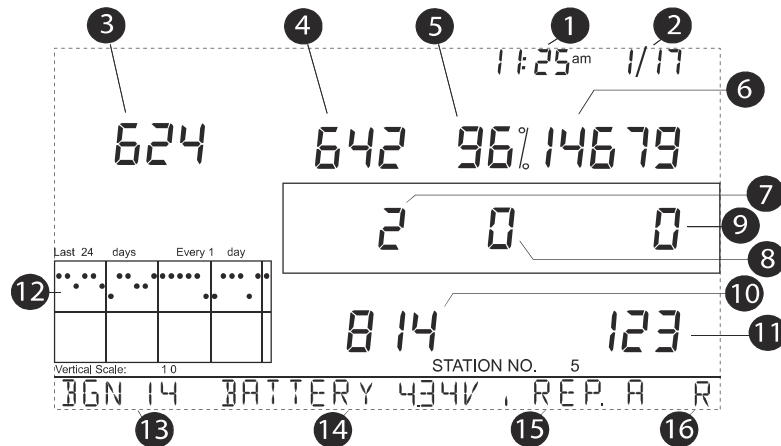
Note: Radio transmission data used by the diagnostic screens clears each day at midnight.

Diagnostic Screen Commands

- Press and hold TEMP, then press HUM to display the Statistical Diagnostic screen.
- Press the > key to display signal statistics for the next installed transmitter ID.
- Press 2ND and then press CHILL to toggle between the Statistical and Reception Diagnostic screens.
- A degree (°) sign displays in right corner of value 1 of the Reception Diagnostic screen (screen 2) to differentiate which screen is currently displayed.
- Press DONE to exit the diagnostic screen.

Screen 1: Statistical Diagnostic Screen

The Statistical Diagnostic displays information about how data is being received from the weather station to the console. The information that is displayed in this screen includes:



Screen 1: Statistical Diagnostics Screen

Note: All values with a * mark the value as being for Davis Instruments Internal use. All values with a † mark values that are the same on both the Statistical and Reception Diagnostic screens.

1. Time of day or number of times the anemometer reed switch was seen closed*. The reed switch closes once each revolution of the anemometer wind cups. Press WIND to toggle between these two values.
2. Date or the number of times the anemometer reed switch was seen open*. Press WIND to toggle between these two values.

Note: The time and date displays can be toggled in both statistical and reception diagnostic screens.

3. Number of packets containing CRC errors received. The system runs a CRC check on data packets. Any data packets that don't pass this check are considered to contain errors and are discarded. These are considered bad packets.
4. The total number of bad data packets including missed packets and CRC errors. Missed packets are described as when a data packet is expected, but is not recognized as a data packet by the console.
5. Percentage of good packets received.
6. Total number of good packets received.
7. Number of times the console resynchronized with the transmitter. The console will attempt to resynchronize with the station after 20 consecutive bad packets.
8. Maximum number of bad packets in a row without resynchronization.
9. Current streak of consecutive bad packets. The counter increments when the console is synchronized but the packet is bad. This value is reset to zero when a good packet is received.

-
10. Longest streak of consecutive good packets received.
 11. Current streak of consecutive good packets received.
 12. Graph of the daily percentage of good data packets received over the last 24 days.
 13. Background noise level. This refers to the undesirable signal level the console hears while it is in the process of acquiring a signal from a station. The range displayed is from 5 to 60. When the noise level is high, try to move the console closer to the station to get a stronger signal. Small background noise level does not always guarantee good reception. The signal strength between the station and the console needs to be stronger than the background noise level in order for the console to receive clearly. If there are reception problems while a small background noise level is still being displayed, make sure the console is within reasonable range of the station.

If the console currently has acquired all the station signals it is set to receive, the background noise level displayed is the last noise level measurement taken before acquisition finished.
 14. Current console battery voltage. Ignore this value if using the AC Adapter only to power the console.
 15. Repeater ID currently communicating with the console. If a repeater or group of repeaters is used to relay station information to the console, the Repeater ID displayed is the repeater that the console is set to receive. If the console is not listening to repeaters, this section remains blank. Please see Application Note 25 available on the Davis Instruments Support web page for more information on using repeaters.
-

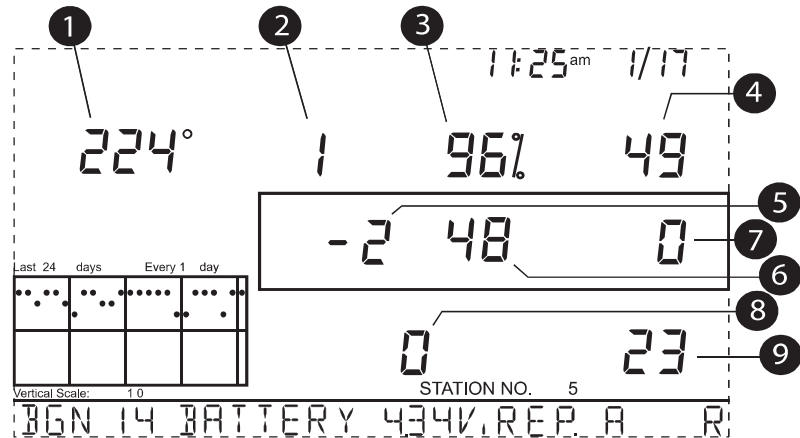
Note: The Repeater ID does not display in the ticker banner in firmware versions earlier than May 2005, or Version 1.6. If you want your console to support repeater communication, upgrade your console to the most recent console firmware version.

16. The console's reception status. See "Troubleshooting Reception Problems" on page 35 for information on the status types.

Screen 2: Reception Diagnostic Screen

The Reception Diagnostic screen displays information pertinent to the console's wireless reception. To view this screen from the Statistical Diagnostic screen, press 2ND and then press CHILL. The degree sign displaying in the upper left corner next to value 1 verifies that the Reception Diagnostic screen is currently displayed.

The information that is displayed in this screen includes:



Screen 2: Reception Diagnostics Screen

1. 8-bit timer value of next reception.*
2. Radio frequency error of the last packet received successfully. In normal operation, this value is +1, -1, or 0. This value affects the value of #5 on the next page.
3. Percentage of good data packets.‡
4. Signal strength of the last packet received. The values displayed in this field should generally be between 20 and 60. If a packet is not received successfully, the signal strength field is dashed out (--).
5. Current frequency correction factor. Shows the Automatic Frequency Control setting.
6. Frequency index of the next packet to be received.*
7. Current number of consecutive bad packets.‡
8. The number of times that the Phase Lock Loop did not lock.*
9. Current streak of consecutive good packets received.‡

Console Firmware Versions

In some cases, the problem may be that your console firmware doesn't support what you are trying to do. Use this command to determine the firmware revision level in your console. You can find more information on Vantage Pro2 console firmware versions and changes in the Weather Software Support section of our website. - for information.

Press and hold DONE then press the + key at the same time to display the console firmware version in the ticker at the bottom of the screen.

Console Maintenance

Changing Batteries

Use this procedure to change console batteries without losing any stored weather data or console configuration settings.

1. Plug in the AC adapter or, if the AC adapter is not present, enter Setup Mode by pressing DONE and then the - key.

Note: If you cannot plug in the AC Adapter, entering Setup Mode makes sure the station isn't writing any data to memory when power is removed and avoids data loss.

2. Remove the battery cover located on the back of the console by pressing down on the two latches at the top of the cover.
3. Place the console face down on a flat, firm surface.
4. Insert a fingertip between the two exposed batteries then press the middle battery down toward the notch (toward the "hidden" battery). This will relieve tension on the first battery and allow you to remove it.
5. Remove the old batteries and install the new batteries.
6. Replace the battery cover and remove the AC power adapter, if used.
7. Check and set date and time if power was lost.

One Year Limited Warranty

For details on our warranty policy, please refer to the *Maintenance, Service, and Repair Information* brochure included with your station.

Appendix A

Weather Data

Refer to this appendix to learn more about the weather variables that are measured, displayed, and logged by your Vantage Pro2 Station. Some weather variables require optional sensors. See “Optional Sensors & Transmitting Stations” starting on page 2.

Wind

The anemometer measures wind speed and direction, and is part of the Integrated Sensor Suite (ISS). The console calculates a 10-minute average wind speed and 10-minute dominant wind direction. The 10-minute average wind speed is displayed in the console ticker whenever wind has been selected on the console. The last six 10-minute dominant wind directions are included in the compass rose wind display.

Temperature

The ISS houses the outside temperature sensor in a vented and shielded enclosure that minimizes the solar radiation induced temperature error. The console houses the inside temperature sensor. Additional temperature sensors are available for wireless stations and can measure up to eight locations.

Apparent Temperatures

Vantage Pro2 calculates three apparent temperature readings: Wind Chill, Heat Index, and the Temperature/Humidity/Sun/Wind (THSW) Index. Apparent temperatures use additional weather data to calculate what a human body perceives the temperature to be in those conditions.

Wind chill

Wind chill takes into account how the speed of the wind affects our perception of the air temperature. Our bodies warm the surrounding air molecules by transferring heat from the skin. If there's no air movement, this insulating layer of warm air molecules stays next to the body and offers some protection from cooler air molecules. However, wind sweeps that warm air surrounding the body away. The faster the wind blows, the faster heat is carried away and the colder you feel. Wind has a warming effect at higher temperatures.

Note: Wind chill is not calculated above 92° F (33° C).

Heat Index

The Heat Index uses temperature and the relative humidity to determine how hot the air actually “feels.” When humidity is low, the apparent temperature will be lower than the air temperature, since perspiration evaporates rapidly to cool the body. However, when humidity is high (*i.e.*, the air is more saturated with water vapor) the apparent temperature “feels” higher than the actual air temperature, because perspiration evaporates more slowly.

Note: Heat Index is equal to the air temperature at or below 0° F (-18° C).

Temperature/Humidity/Sun/Wind (THSW) Index

The THSW Index uses humidity and temperature like for the Heat Index, but also includes the heating effects of sunshine and the cooling effects of wind (like wind chill) to calculate an apparent temperature of what it “feels” like out in the sun. The THSW Index requires a solar radiation sensor.

Humidity

Humidity itself simply refers to the amount of water vapor in the air. However, the total amount of water vapor that the air can contain varies with air temperature and pressure. Relative humidity takes into account these factors and offers a humidity reading which reflects the amount of water vapor in the air as a percentage of the amount the air is capable of holding. Relative humidity, therefore, is not actually a measure of the amount of water vapor in the air, but a ratio of the air’s water vapor content to its capacity. When we use the term humidity in the manual and on the screen, we mean relative humidity.

It is important to realize that relative humidity changes with temperature, pressure, and water vapor content. A parcel of air with a capacity for 10 g of water vapor which contains 4 g of water vapor, the relative humidity would be 40%. Adding 2 g more water vapor (for a total of 6 g) would change the humidity to 60%. If that same parcel of air is then warmed so that it has a capacity for 20 g of water vapor, the relative humidity drops to 30% even though water vapor content does not change.

Relative humidity is an important factor in determining the amount of evaporation from plants and wet surfaces since warm air with low humidity has a large capacity to absorb extra water vapor.

Dew Point

Dew point is the temperature to which air must be cooled for saturation (100% relative humidity) to occur, providing there is no change in water vapor content. The dew point is an important measurement used to predict the formation of dew, frost, and fog. If dew point and temperature are close together in the late afternoon when the air begins to turn colder, fog is likely during the night. Dew point is also a good indicator of the air’s actual water vapor content, unlike relative humidity, which takes the air’s temperature into account. High dew point indicates high water vapor content; low dew point indicates low water vapor content. In addition a high dew point indicates a better chance of rain, severe thunderstorms, and tornados.

You can also use dew point to predict the minimum overnight temperature. Provided no new fronts are expected overnight and the afternoon relative humidity is greater than or equal to 50%, the afternoon’s dew point gives you an idea of what minimum temperature to expect overnight, since the air can never get colder than the dew point. Dew point is equal to air temperature when humidity = 100%.

Rain

Vantage Pro2 incorporates a tipping-bucket rain collector in the ISS that measures 0.01" for each tip of the bucket. A metric adapter can be installed to measure 0.2 mm for each tip of the bucket. Your station logs rain data in the same units it is measured in and converts the logged totals into the selected display units (inches or millimeters) at

the time it is displayed. Converting at display time reduces possible compounded rounding errors over time.

Four separate variables track rain totals: “rain storm,” “daily rain,” “monthly rain,” and “yearly rain.” Rain rate calculations are based on the interval of time between each bucket tip, which is each 0.01" rainfall increment or 0.2 mm.

Barometric Pressure

The weight of the air that makes up our atmosphere exerts a pressure on the surface of the earth. This pressure is known as atmospheric pressure. Generally, the more air above an area, the higher the atmospheric pressure, this means that atmospheric pressure changes with altitude. For example, atmospheric pressure is greater at sea level than on a mountaintop. To compensate for this difference and facilitate comparison between locations with different altitudes, atmospheric pressure is generally adjusted to the equivalent sea level pressure. This adjusted pressure is known as barometric pressure. In reality, the Vantage Pro2 measures atmospheric pressure. When you enter your location's altitude in Setup Mode, the Vantage Pro2 stores the necessary offset value to consistently translate atmospheric pressure into barometric pressure.

Barometric pressure also changes with local weather conditions, making barometric pressure an extremely important and useful weather forecasting tool. High pressure zones are generally associated with fair weather while low pressure zones are generally associated with poor weather. For forecasting purposes, however, the absolute barometric pressure value is generally less important than the change in barometric pressure. In general, rising pressure indicates improving weather conditions while falling pressure indicates deteriorating weather conditions.

Solar Radiation

What we call “current solar radiation” is technically known as Global Solar Radiation, a measure of the intensity of the sun's radiation reaching a horizontal surface. This irradiance includes both the direct component from the sun and the reflected component from the rest of the sky. The solar radiation reading gives a measure of the amount of solar radiation hitting the solar radiation sensor at any given time, expressed in Watts/sq. meter (W/m^2). Solar radiation requires the solar radiation sensor.

UV (Ultra Violet) Radiation

Energy from the sun reaches the earth as visible, infrared, and ultraviolet (UV) rays. Exposure to UV rays can cause numerous health problems, such as sunburn, skin cancer, skin aging, cataracts, and can suppress the immune system. The Vantage Pro2 helps analyze the changing levels of UV radiation and can advise of situations where exposure is particularly unacceptable. UV radiation requires the UV radiation sensor. The Vantage Pro2 displays UV readings in two scales: MEDs and UV Index.

Note: Your station's UV readings do not take into account UV reflected off snow, sand, or water, which can significantly increase your exposure. Nor do your UV readings take into account the dangers of prolonged UV exposure. The readings do not suggest that any amount of exposure is safe or healthful. Do not use the Vantage Pro2 to determine the amount of UV radiation to which you expose yourself. Scientific evi-

dence suggests that UV exposure should be avoided and that even low UV doses can be harmful.

UV MEDs

MED (Minimum Erythmal Dose) is defined as the amount of sunlight exposure necessary to induce a barely perceptible redness of the skin within 24 hours after sun exposure. In other words, exposure to 1 MED will result in a reddening of the skin. Because different skin types burn at different rates, 1 MED for persons with very dark skin is different from 1 MED for persons with very light skin.

Both the U.S. Environmental Protection Agency (EPA) and Environment Canada have developed skin type categories correlating characteristics of skin with rates of sunburn.

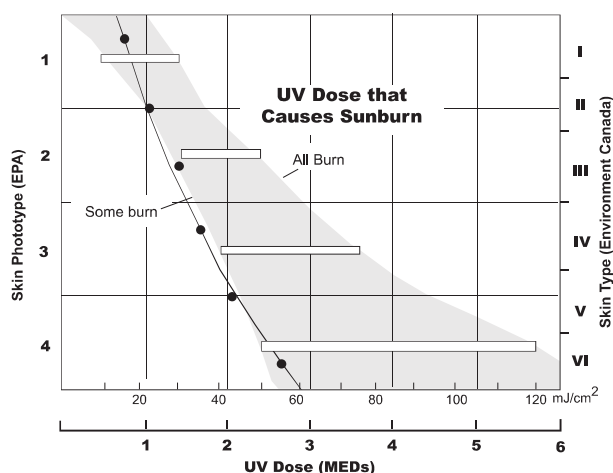
TABLE A-1: EPA SKIN PHOTOTYPES

Skin Phototype	Skin Color	Tanning & Sunburn history
1 - Never tans, always burns	Pale or milky white; alabaster	Develops red sunburn; painful swelling, skin peels
2 - Sometimes tans, usually burns	Very light brown; sometimes freckles	Usually burns, pinkish or red coloring appears; can gradually develop light brown tan
3 - Usually tans, sometimes burns	Light tan; brown, or olive; distinctly pigmented	Rarely burns; shows moderately rapid tanning response
4 - Always tans; rarely burns	Brown, dark brown, or black	Rarely burns; shows very rapid tanning response

TABLE A-2: ENVIRONMENT CANADA SKIN TYPES AND REACTION TO THE SUN^A

Skin Type	Skin Color	History of Tanning & Sunburning
I	White	Always burns easily, never tans
II	White	Always burns easily, tans minimally
III	Light Brown	Burns moderately, tans gradually
IV	Moderate Brown	Burns minimally, tans well
V	Dark Brown	Burns rarely, tans profusely
VI	Black	Never burns, deep pigmentation

a. Developed by T. B. Fitzpatrick of the Harvard Medical School. More about the Fitzpatrick Skin Types is available in: Fitzpatrick TB. Editorial: the validity and practicality of sun-reactive skin types I through VI. Arch Dermatol 1988; 124:869-871



UV Dose and Sunburn - Use this plot to estimate the MED dose leading to sunburn. A person with Type II (Environment Canada) skin type might choose 0.75 MED as the maximum for the day; in contrast, a person with Type V (Environment Canada) Skin Type might consider 2.5 MEDs a reasonable dose for the day. NOTE: the Vantage Pro2 assumes a Fitzpatrick (Environment Canada) Skin Type of II.

UV Index

Vantage Pro2 can also display UV Index, an intensity measurement first defined by Environment Canada and since been adopted by the World Meteorological Organization. UV Index assigns a number between 0 and 16 to the current UV intensity. The US EPA categorizes the Index values as shown in table A-3. The lower the number, the lower the danger of sunburn. The Index value published by the U.S. National Weather Service is a forecast of the next day's noontime UV intensity. The index values displayed by the Vantage Pro2 are real-time measurements.

TABLE A-3: UV INDEX

Index Values	Exposure Category
0 - 2	Low
3 - 4	Moderate
5 - 6	High
7 - 9	Very High
10+	Extreme

Evapotranspiration (ET)

Evapotranspiration (ET) is a measurement of the amount of water vapor returned to the air in a given area. It combines the amount of water vapor returned through evaporation (from wet surfaces) with the amount of water vapor returned through transpiration (exhaling of moisture through plant stomata) to arrive at a total. Effectively, ET is the opposite of rainfall, and it is expressed in the same units of measure (inches, millimeters).

The Vantage Pro2 uses air temperature, relative humidity, average wind speed, and solar radiation data to estimate ET, which is calculated once an hour on the hour. ET requires the optional solar radiation sensor.

Leaf Wetness

Leaf wetness (see “Optional Sensors & Transmitting Stations” on page 2) provides an indication of whether the surface of foliage in the area is wet or dry by indicating how wet the surface of the sensor is. The leaf wetness reading ranges from 0 (dry) to 15. Leaf wetness requires an optional Leaf & Soil Moisture/Temperature Station and is only available for Wireless Vantage Pro2 Stations.

Soil Moisture

Soil Moisture, as the name suggests, is a measure of the moisture content of the soil. Soil moisture is measured on a scale of 0 to 200 centibars, and can help choose times to water crops. The soil moisture sensor measures the vacuum created in the soil by the lack of moisture. A high soil moisture reading indicates dryer soil; a lower soil moisture reading means wetter soil. Soil Moisture requires an optional Leaf & Soil Moisture/Temperature Station or Soil Moisture Station and is only available for Wireless Vantage Pro2 Stations.

Time

The console has a built-in clock and calendar track the time and date. It automatically adjusts for daylight saving time in most of North America and Europe (and allows manual adjustment elsewhere) and for leap years, providing you have entered the correct year, latitude and longitude, and dayling saving settings in the Setup Mode.

Appendix B

Specifications

See complete specifications for your Vantage Pro2 Station at our website:
www.davisnet.com.

Console Specifications

Console Operating Temperature	+32° to +140°F (0° to +60°C)
Non-operating Temperature	+14° to +158°F (-10° to +70°C)
Console Current Draw	Wireless: 0.9 mA average, 30 mA peak, (add 120 mA for display lamps, add 0.125 mA for each optional transmitter station received by console) at 4 to 6 VDC Cabled: 10 mA (average), 15 mA (peak) (+80 mA for illuminated display) at 4 to 6 VDC
Power Adapter	5 VDC, 300 mA
Battery Backup	3 C-cells
Battery Life (no AC power)	Wireless: up to 9 months; (Cabled: approximately 1 month)
Connectors	Modular RJ-11
Housing Material.	UV-resistant ABS plastic
Console Display Type	LCD Transflective
Display Backlight	LEDs
Dimensions:	
Console (with antenna)	10.625" x 6.125" x 1.625" (270 mm x 156 mm x 41 mm)
Console (no antenna)	9.625" x 6.125" x 1.625" (244 mm x 156 mm x 41 mm)
Display	5.94" x 3.375" (151 mm x 86 mm)
Weight (with batteries).	1.88 lbs. (.85 kg)

Wireless Communication Specifications

Transmit/Receive Frequency	
US Models:	902 - 928 MHz FHSS
Overseas Models:	868.0 - 868.6 MHz FHSS
ID Codes Available	8
Output Power	902 - 928 MHz FHSS: FCC-certified low power, less than 8 mW, no license required 868.0 -868.6 MHz: CE-certified, less than 8 mW, no license required
Range	
Line of Sight	up to 1000 feet (300 m)
Through Walls.	200 to 400 feet (75 to 120 m)

Console Data Display Specifications

Historical Data	Includes the past 24 values listed unless otherwise noted; all can be cleared and all totals reset.
Daily Data	Includes the earliest time of occurrence of highs and lows; period begins/ends at 12:00 am.
Monthly Data	Period begins/ends at 12:00 am on the first of every month.
Yearly Data	Period begins/ends at 12:00 am on January 1 st unless otherwise noted.
Current Graph Data	Current data appears in the right most column in the console graph and represents the latest value within the last period of the graph; totals can be set or reset.
Graph Time Interval	1 min., 10 min., 15 min., 1 hour, 1 day, 1 month, 1 year (user-selectable, availability depends upon variable selected).
Graph Time Span	24 Intervals + Current Interval (see Graph Intervals to determine time span).
Graph Variable Span (Vertical Scale)	Automatic (varies depending upon data range); maximum and minimum value in range appear in ticker.
Alarm Indication	Alarms sound for 2 minutes (time alarm is 1 minute) if operating on battery power. Alarm message displays in ticker as long as threshold is met or exceeded. Alarms can be silenced, but not cleared, by pressing DONE.
Transmission Interval	Varies with transmitter ID code - from 2.25 seconds (ID1 = shortest) to 3 seconds (ID8 = longest).
Update Interval	Varies with sensor - see individual sensor specs.
Forecast:	
Variables Used	Barometric reading & trend, wind speed & direction, rainfall, temperature, humidity, latitude & longitude, time of year.
Update Interval	1 hour
Display Format	Icons on top center of display; detailed message in ticker at bottom.
Variables Predicted	Sky condition, precipitation, temperature changes, wind direction and speed changes.

Weather Data Specifications

Note: These specifications include optional sensors that may not be installed in your Vantage Pro2 Station.

Weather Data Specifications

Variable	Required Sensors	Resolution	Range	Nominal Accuracy (+/-)
Barometric Pressure*	Included in Console	0.01" Hg; 0.1 mm; 0.1 hPa; 0.1 mb	16" to 32.5" Hg 410 to 820 mm 540 to 1100 hPa 540 to 1100 mb**	0.03" Hg 0.8 mm Hg 1.0 hPa 1.0 mb
Barometric Trend (3 hour)		Change Rates Rapidly: ≥ 0.06 " Hg 1.5 mm Hg 2 hPa, 2 mb; Slowly: ≥ 0.02 " Hg 0.5 mm Hg 0.7 hPa, 0.7 mb	5 Arrow Positions: Rising Rapidly Rising Slowly Steady Falling Slowly Falling Rapidly	
Evapotranspiration (ET)	ISS or Temp/ Hum Station & Solar Radiation sensor	0.01"; 0.1 mm	Daily to 32.67"; 832.1 mm Monthly & Yearly to 199.99"; 1999.9 mm	greater of 5% or 0.01"; 0.25 mm
Inside Humidity	Included in Console	1%	1 to 100%	3% RH; 4% above 90%
Outside Humidity	ISS or Temp/ Hum Station	1%	1 to 100%	3% RH; 4% above 90%
Extra Humidity	ISS or Temp/ Hum Station	1%	1 to 100%	3% RH; 4% above 90%
Dew Point (overall)	ISS or Temp/ Hum Station	1°F; 1°C	-105° to +130°F; -76° to +54°C	3°F; 1.5°C
Leaf Wetness	Leaf & Soil Station	1	0 to 15	0.5
Soil Moisture	Leaf & Soil Station or Soil Moisture Station	1 cb	0 to 200 cb	
Daily & Storm Rainfall	Rain Collector	0.01"; 0.2 mm	to 99.99"; 999.8 mm	greater of 4% or 1 tip,
Monthly & Yearly Rainfall		0.01"; 0.2 mm (1mm at totals over 2000 mm)	to 199.99"; 6553 mm	greater of 4% or 1 tip
Rain Rate		0.01"; 0.2 mm	to 96"/hr.; 2438 mm/hr.	greater of 5% or 0.04"/hr.; 1 mm/hr.

*Barometric pressure readings are standardized to sea level. Elevation Range: -999' to +15,000'; -600 to + 4570 m. Note: The console screen limits display of lower elevation to -999' when using feet as elevation unit. For elevations lower than -999', use meters.

**This is the reduced value after standardizing to sea level.

Weather Data Specifications

Variable	Required Sensors	Resolution	Range	Nominal Accuracy (+/-)
Solar Radiation	Solar sensor	1 W/m ²	0 to 1800 W/m ²	5% of full scale
Inside Temperature	Included in Console	0.1°F; 0.1°C	+32° to +140°F; 0 to +60°C	1°F; 0.5°C
Outside Temperature ***	ISS, Temp Station or Temp Hum Station	0.1°F; 0.1°C	-40° to +150°F; -40° to +65°C	1°F; 0.5°C
Extra Temperature	ISS, Temp Station, Temp Hum Station, Leaf Soil Station or Soil Station	1°F; 1°C	-40° to +150°F; -40° to +65°C	1°F; 0.5°C
Heat Index	ISS or Temp/Hum Station	1°F; 1°C	-40° to +165°F; -40° to +74°C	3°F (1.5°C)
Temp-Hum-Sun-Wind index (THSW)	ISS & Solar Radiation	1°F; 1°C	-90° to +165°F; -68° to +74°C	4°F (2°C)
Time	Included in Console	1 min	24 hours	8 sec./mon.
Date		1 day	month/day	8 sec./mon.
UV Index	UV Radiation	0.1 Index	0 to 16	5% of full scale
UV Dose		0.1 MED < 20, 1 MED > 20	0 to 199 MEDs	5%
Wind Direction	Anemometer	1°	0 to 360°	3°
Compass Rose		22.5°	16 compass pts	0.3 compass pt
Wind Speed (large cups)		1 mph; 1 kt; 0.4 m/s; 1 km/h	2 to 180 mph; 2 to 156 kts 3 to 290 km/h, 1 to 80 m/s	greater of 2 mph/kts; 1 m/s; 3 km/h or 5%
Wind Chill	ISS	1°F; 1°C	-110° to +135°F -79° to +57°C	2°F; 1°C

*** Outside temperature accuracy is based on the temperature sensor itself and not on the sensor and the passive shielding together. The solar radiation induced error for standard radiation shield: +4°F (2°C) at solar noon; for fan aspirated radiation shield: +0.6°F (0.3°C) at solar noon (insolation = 1040 W/m², avg. wind speed ≤ 2 mph (1 m/s), reference: RM Young Model 43408 Fan-Aspirated Radiation Shield).

Appendix C

Wireless Repeater Configuration

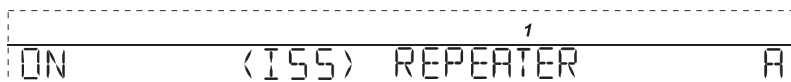
A Vantage Pro2 Wireless Repeater (#7626, #7627) or Long-Range Wireless Repeater (#7653, #7654) increase transmission distances or improve transmission quality between a station and a console. A repeater receives information transmitted from a Vantage Pro2 station and retransmits it to a console. Depending on transmission distance, one repeater or several repeaters can be used to collect and retransmit weather data.

All consoles communicating with repeaters must be set up with the correct Transmitter ID and Repeater ID before the console can correctly receive station information.

To set Repeater ID on the console:

1. Press DONE and the - keys to enter Setup Mode.
2. If Setup Mode has previously been completed, press DONE to display Screen 2: Configuring Transmitter IDs.
3. See “Screen 2: Configuring Transmitter IDs — Wireless Only” on page 10 for more information on configuring Transmitter IDs.
4. Press 2ND and then press WIND to enter Repeater Setup Mode and to select a Repeater ID. Pressing 2ND and WIND sets the console to receive the signal from a repeater instead of directly from a station. Once the console is in the repeater setup mode, subsequent pressing of WIND continue to cycle through the all the repeater IDs.
5. Press WIND repeatedly to cycle through all eight repeater IDs possible or to clear the repeater ID in the right hand corner. When no repeater ID is shown, the console is configured to listen directly to a station and not to a repeater.

In the example below, the console is set up to receive an ISS station on transmitter ID 1 from repeater A.



The screenshot shows a monochrome LCD display with a dashed border. The text on the screen is 'ON (ISS) REPEATER A'. Above the letter 'A' is a small number '1'. The text is in a simple, blocky font typical of handheld electronic devices.

6. For each station using a repeater, select the station and turn on the repeater function and select the correct repeater ID.
7. Press DONE to continue to the other screens in the Setup Mode, or press and hold DONE to return to the Current Weather Mode.

Note: In console with the October 2005 version of firmware, the only way to exit Repeater Setup mode is to press DONE to continue to the next setup screen.

Verifying Setup

To verify that you have successfully set up your console to receive a repeater in the console's Current Weather Mode:

1. View the transmitter information displaying at the bottom of the console screen.

If the transmitter ID being repeated is displayed and an “X” flashes in the bottom right corner of the ticker tape, the transmitter is being repeated and received by the console successfully.

The repeater’s information also displays at the bottom of the console’s diagnostics screens.

Clearing Repeater ID

If a repeater ID is being displayed in Screen 2 and you are not using a repeater with the selected station, you must turn off the repeater function to receive station information successfully.

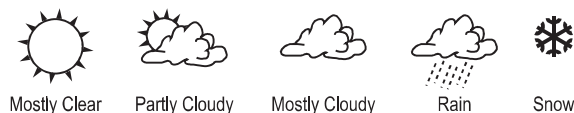
In Setup Screen 2:

Press 2ND and then press WIND repeatedly so that the console cycles through the list of repeater IDs (Repeaters A-H) until the section where the repeater ID was displayed is blank. Press DONE to continue to the next screen or press and hold DONE to return to the Current Weather Mode.

Vantage Pro2 Console Icons

Console icons indicate weather conditions and special functions.

Forecast



Indicates the weather forecast for the next 12 hours.

Moon Phase



Shows the current moon phase. Sequence shown for Northern Hemisphere. The sequence of the icons is reversed in the Southern Hemisphere.

Alarm Bell

Flashes when an alarm is triggered. Also indicates when the console is in Alarm Mode.



Graph

Appears next to the currently selected weather variable. Also indicates the graphed variable on most screens.



Second Function

Appears when you press 2ND key. Indicates that console key secondary functions are enabled.



Rain

Appears when the console is currently detecting rain.



Barometric Pressure Trend

Arrows show direction of pressure change for last three hours.



Contacting Davis Technical Support

For questions about installing or operating your Vantage Pro2 weather station, please contact Davis Technical Support. We'll be glad to help.

(510) 732-7814 — Monday - Friday, 7:00 a.m. - 5:30 p.m. Pacific Time. We are unable to accept collect calls.

(510) 670-0589 — Technical Support Fax.

support@davisnet.com — E-mail to Technical Support.

info@davisnet.com — General e-mail.

www.davisnet.com — Davis Instruments web site. See the Weather Support section for copies of user manuals, product specifications, application notes, and information on software updates. Watch for FAQs and other updates.

3700 Portable Sampler

This pocket guide is not intended to replace the instruction manual. Read the instruction manual thoroughly before operating the sampler.

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www.isco.com

Part #60-3703-149
Revision K, March 27, 2012

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3700 Portable Sampler

Section 1 Setup Procedures

This section explains how to place the sampler into operation by preparing the base section, attaching the suction line, connecting a power source, installing the sampler at the site, placing the suction line inlet in the liquid source, and interfacing an external flow meter (if used).

1.1 Preparing the Base for Sequential Sampling

The sequential base section is supplied with 24 glass bottles (350-ml) or polypropylene bottles (1000-ml). Either glass or plastic bottles can be used, but glass and plastic bottles cannot be mixed in the same base section.

The stainless steel retaining ring for the glass bottles expands to hold the bottles against the inside wall of the base. Remove the retaining ring by squeezing the ring until it contracts; then lift the ring out of the base section.

The plastic retaining ring for the plastic bottles is held in place by three draw cords attached to the bottom of the base and hooked to the retaining ring. Detach the ring by disconnecting the draw cords from the hooks on the ring. Always use the ring when ice is used to cool the samples. Otherwise, the melt water will cause the plastic bottles to float and obstruct the distributor arm.

1.2 Attaching the Suction Line

The suction line is the piece of tubing extending from the pump tubing intake to the liquid source. There are three standard suction lines: vinyl tubing in $\frac{1}{4}$ inch (0.64 cm) or $\frac{3}{8}$ inch (0.94 cm) inside diameters, or FEP PTFE in $\frac{3}{8}$ inch inside diameter.

Vinyl suction line is attached to the pump tubing with the tube coupling. First, screw the threaded end into the suction line until the flat surface is flush against the suction line. Then, push the other end of the coupler into the end of the pump tube until the other flat surface is flush against the tubing.

The PTFE line is attached to the pump tubing by inserting the line into the pump tubing and securing it with a suitable clamp.

1.3 Placement of Suction Line and Intake

Route the line from sampler to sampling point so it is always sloped downhill. Avoid coiled suction line which may hold residual liquid. This minimizes cross contamination. Be sure the vertical distance between the level of the liquid source and the pump is less than 26 feet. The pump will not deliver samples for heads greater than 26 feet.

The suction line tends to float in deep flow streams, dislodging the line and strainer. Table 1-1 shows the maximum depths you can submerge the lines and strainers without risks of flotation. At depths exceeding the safe depths, anchor the line and strainer securely.

The $\frac{3}{8}$ inch ID vinyl suction lines are shipped from the factory with our standard weighted polypropylene strainer installed on one end of the suction line and a tubing coupling on the other end.

Additionally, Teledyne Isco offers two low flow stainless steel strainers for $\frac{1}{4}$ inch ID and $\frac{3}{8}$ inch ID suction lines. For installation in PTFE suction line, heat the end of the suction line to make it more flexible, then carefully screw the strainer's threaded connector into the suction line.

**Table 1-1 Safe Depths of Submersion
for Suction Line**

Strainer	Vinyl 1/4" (6 mm)	Vinyl 3/8" (9 mm)	PTFE 3/8" (9 mm)
Standard Weighted Polypropylene	-----	22 feet (6.7 m)	15 feet (4.5 m)
Stainless Steel Low Flow	14 feet (4.3 m)	22 feet (6.7 m)	15 feet (4.5 m)
CPVC	-----	4 feet (1.2 m)	4 feet (1.2 m)

For sampling from highly acidic flow streams, a weighted plastic CPVC strainer is available.

1.4 Connecting to Power Source

The 3700 Sampler must be supplied with power from an AC Power Pack, an Isco Nickel Cadmium Battery Pack, an Isco lead-acid battery, or an external 12 VDC source such as an automotive or marine battery.

1.4.1 Mounting Isco Power Sources

Place the power source in the recess at the rear of the center section. Stretch the two black rubber draw catches up and into the “U” shaped receptacles on either side of the source. Attach the connector on the short cable of the power

source to the 12 VDC connector on the control box.

1.4.2 External 12 VDC Source

The 3700 Sampler can be powered with a 12 V automotive or marine battery. A cable terminating in battery clips connects the sampler to the battery. Plug the connector on the end of the external battery cable into the “12 VDC” connector on the control box. Connect the cable clips to the battery terminals. The positive lead of the cable is painted red and stamped with a plus sign.

1.5 Flow Meter Connection

For flow-proportional sampling, attach the flow-meter connect cable to the flow meter and to the 6-pin flow meter connector on the rear of the sampler.

If a cable is not attached to the flow-meter connector, keep the protective cap tightly screwed in place to keep the control box watertight.

1.6 Placing the Sampler into Operation

Install the sampler in a level position. It can be suspended during operation by the optional suspension harness. Start the sampling program with the Start Sampling key.

1.7 Restarting

The sampler may be started again by pressing the Start Sampling key. Reprogram the start time, if necessary.

1.8 Field Printer and Computer Connections

To collect data from the sampler, attach the field printer or interrogator cable to the sampler's 6-pin printer connector.

Both the field printer and the interrogator cable are compatible with Isco's 25-foot extension cable. If preferred, install the extension cable on the sampler's printer connector and route the cable to an alternate location.



CAUTION

If an interrogator cable is not attached to the printer connector on the sampler or the unattached end of the extension cable, keep the connector cap tightly screwed in place. This will prevent moisture damage to the connectors and to the control box.

1.9 Master/Slave Connections

If operating a pair of samplers configured for Master/slave operation, connect the samplers with the Master/Slave Interconnect Cable by attaching the cable to the flow-meter connector on both samplers. Configure both samplers for the master/slave mode in the Enable Pin configure option. Start master/slave sampling

by pressing Start Sampling on both machines. The samplers cannot reverse roles if both samplers are not in the run state. The first machine started becomes the master.

1.10 Recovering the Sampler

When recovering the sampler, keep it level to avoid spilling the collected samples. Cap the sample container(s) before transporting them. If the sampler is not to be returned to the office, install a base section with empty bottles and start the sampler again.

1.11 Conversion for Composite Sampling

To convert the 3700 Sampler for composite sampling:

1. Separate the center section from the rest of the sampler. Next, remove the pump tube. Disconnect the distributor arm.
2. Turn the center section over and install the float and float cage. Install the shaft on the “diving-bell” float in the hole in the distributor shaft. Attach the float cage to the center section with the four screws and 1-inch spacers provided with the float cage kit (Figure 1-1).

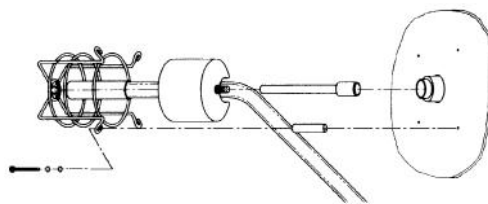


Figure 1-1 Float Cage Installation

3. Feed the 34.5-inch (88.5-cm) composite pump tube through the port in the center section, place it in the float cage tube guide, and install it in the pump.
4. Check the bottle number and size settings in the Bottles and Sizes configure option (Refer to Section 2). Set the bottle number to “1” and enter the appropriate bottle volume.

☑ Note

Composite sampling routines can be programmed in both the basic and extended programming mode. To use nonuniform times or sampling stops and resumes in a composite sampling application, use the extended programming mode.

1.11.1 Standard base section

There are two sizes of composite containers: 2.5-gallon (9400-ml) glass or polyethylene and 4-gallon (15000-ml) polyethylene. The 2.5-gallon containers require the standard base section composite bottle locating deck. Prepare the standard base by placing the locating deck,

open side down, in the bottom of the base section. Then, place the sample container on the locating deck and re-assemble the sampler.

1.11.2 Optional Composite Base Section

The 4-gallon wide mouth composite bottle requires the composite base. No locating deck is required. Simply place the 4-gallon bottle in the composite base.

 Note

When cooling composite samples with ice, melt water may cause the bottle to float when you remove the center section.

3700 Portable Sampler

1-10

3700 Portable Sampler

Section 2 *Programming*

The sampler's programming process is self-prompting. Prompts displayed on the LCD step you through the program in a logical order, indicating the needed value or option. The sampler will reject any unacceptable settings. Settings can be changed at any time. If the sampler is turned off or power disconnected, settings are retained in memory by a lithium battery. Before programming the sampler, you should be familiar with the keypad and displays. These are discussed in later sections.

2.1 Operating States

The sampler has three operating states:

1. The *standby state*: the sampler is waiting for instructions from the keypad.
2. The *run state*: the sampler is running a sampling routine, displaying status messages on the LCD, and storing sampling results in memory.
3. The *interactive state*: the sampler is being programmed.

2.2 Interactive State

The interactive state allows you to program the sampler. It is divided into two branches: the configure sequence and the program sequence. The configure sequence contains the input displays that configure the sampler to your unique requirements. The program sequence has two programming modes: basic and extended. The basic mode is used for conventional sampling routines. The extended mode is for more complex routines. (Select the mode in the Programming Mode configure option.)

In both programming modes, the program sequence is divided into four sections: Sample Pacing (interval between samples), Sample Distribution (number of samples in each bottle), Sample Volume (sample size in ml), and Key Times (start times and, in the extended mode, stop and resume times).

Sampling capabilities available through the basic and extended program modes are summarized in Table 2-1. Setup options available in the configure sequence are listed in Table 2-2.

Table 2-1 Sampling Capabilities

Pacing:	Mode	Feature
Time-pacing: Uniform Time Intervals	Basic & Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.
Time-pacing: Nonuniform Clock Time Intervals	Extended	Samples taken at irregular intervals by specifying the time and date of each sample. Dates can be entered up to 1 month in advance of current date.
Time-pacing: Nonuniform Intervals in Minutes	Extended	Samples taken at irregular time intervals by specifying the amount of time in minutes (from 1 to 999 minutes) between each sample.
Flow-pacing:	Basic & Extended	Samples taken at regular flow intervals. The sampler will totalize intervals of 1 to 9999 pulses.
Storm™ Pacing:	Extended	Combines time and flow pacing in one routine. Timed samples taken at regular time intervals from 1 minute to 999 minutes. Flow-weighted samples taken at regular flow intervals. The sampler will totalize intervals of 1 to 9999 pulses.

Table 2-1 Sampling Capabilities (Continued)		
Distribution:		
Sequential	Basic & Extended	One sample volume placed in each bottle.
Samples per Bottle Multiplexing	Basic & Extended	More than one sample volume placed in each bottle.
Bottles per Sample Multiplexing	Basic & Extended	Sample volumes placed in more than one bottle at each sample event.
Multiple Bottle Compositing	Extended	More than one sample placed in a set of bottles. Bottle sets can be switched after a specified number of samples or after a period of time.
Volumes and Accuracy:		
Sample Volume	Basic & Extended	Volumes from 10 to 9990 ml can be entered.
Suction Head	Basic & Extended	Suction heads from 1 to 20 feet can be entered.
Calibration	Basic & Extended	Sample volumes can be calibrated, if desired.
Key Times:		
Start Times	Basic & Extended	Specific start times can be entered for both time- and flow-paced routines. If no start time is entered, the Start Time Delay will be used.

**Table 2-1 Sampling Capabilities
(Continued)**

First Switch Time	Extended	Sets time of first time-base bottle switch so that switch times can be placed on schedule.
Stop/Resume Times	Extended	Intermittent sampling routines defined with sampling stop and resume times. Up to 12 stop times and 12 resume times can be entered.

Table 2-2 Configure Option Functions

Configure Option	Mode	Function
Set Clock	Basic & Extended	Sets the sampler's real time clock.
Bottles and Sizes	Basic & Extended	Sets the number and size of bottles used.
Suction Line	Basic & Extended	Sets the line type (vinyl or PTFE), line diameter ($\frac{1}{4}$ or $\frac{3}{8}$ inch), and line length (3 to 99 ft.).
Liquid Detector	Basic & Extended	Enables/disables the liquid detector, sets the number of rinses (0 to 3), enables/disables the suction head entry, and sets the number of retries (0 to 3).
Programming Mode	Basic & Extended	Sets the programming mode: basic or extended.

Table 2-2 Configure Option Functions (Continued)		
Configure Option	Mode	Function
Load Stored Program	Extended	Loads one of up to three previously saved sampling programs.
Save Current Program	Extended	Saves current sampling program.
Flow Mode Sampling	Extended	Directs sampler to take a sample at the beginning of a flow-paced program and/or at time-switches.
Nonuniform Time	Extended	Directs sampler to accept nonuniform intervals as clock times or in minutes.
Calibrate Sampler	Basic & Extended	Enables/disables the calibration sequence.
Sampling Stop/Resume	Extended	Enables/disables Sampling Stops and Resumes feature.
Start Time Delay	Basic & Extended	Sets the start time delay (from 0 to 9999 minutes).
Enable Pin	Basic & Extended	Enables/disables master/slave sampling. Directs the sampler to sample when disabled and/or enabled. Allows you to restart the sampling interval upon enable.
Event Mark	Basic & Extended	Allows you to select one of four types of event marks.
Purge Counts	Basic & Extended	Adjusts the pre- and postsample purge counts.

**Table 2-2 Configure Option Functions
(Continued)**

Configure Option	Mode	Function
Tubing Life	Basic & Extended	Displays the pump tubing life information. Resets the tubing life count.
Program Lock	Basic & Extended	Enables/disables the password protection for input displays.
Sampler ID	Basic & Extended	Allows you to enter a 10 character ID number.
Run Diagnostics	Basic & Extended	Tests the RAM, ROM, distributor & pump. Allows for re-initialization.

2.2.1 Keypad Description

Control keys manually control the sampler. Numeric keys enter program values, and programming keys direct programming activities.

Control Keys

- **On/Off** – The ON/OFF key turns the sampler on (placing the sampler in standby) or off. If you turn the sampler off during a routine, resume the routine with the RESUME SAMPLING key.
- **Pump Forward** – In standby, the PUMP FORWARD key runs the pump forward until the STOP key is pressed.

- **Pump Reverse** – In standby, the PUMP REVERSE key runs the pump in reverse until the STOP key is pressed.
- **Stop** – The STOP key stops the pump when it is running. In the run state, it halts the routine and transfers the sampler to standby. Press the STOP key at an input display to see the display's reference number.
- **Start Sampling** – In standby, the START SAMPLING key starts the sampling program. When entering a sampler ID number, the START SAMPLING KEY types a space.
- **Resume Sampling** – When "PROGRAM HALTED" is displayed, press the RESUME SAMPLING key to resume the program from the point it halted. When entering a sampler ID number, the RESUME SAMPLING key types a period.
- **Manual Sample** – The MANUAL SAMPLE key takes a manual sample. The MANUAL SAMPLE key is valid in the standby and run states, and when calibrating the sampler. When entering a sampler ID number, the MANUAL SAMPLE key types a dash (-).
- **Next Bottle** – The Next Bottle key moves the distributor to the next bottle. If the distributor is over the last bottle, the distributor will move to position one.

Program Keys

- **Display Status** – Press the DISPLAY STATUS key in standby to view the program settings or the sampling results.
- **Exit Program** – Press the EXIT PROGRAM key in the program sequence to return to standby. Press the EXIT PROGRAM key in the run state to halt the program.
- **Clear Entry** – When entering a number, press the CLEAR ENTRY key to clear the new entry. The display will return to the original entry.
- **Enter/Program** – Press the ENTER/PROGRAM key in standby to enter the interactive state. At an input display, press ENTER/PROGRAM to store a value or selection.

Numeric Keys

- **Digit Keys** – The digit keys are used to enter quantities.
- **Left Arrow** – The LEFT ARROW key selects one of two or more program options displayed in the interactive state. When more than one numeric entry is displayed, the LEFT ARROW steps back to a previously entered value. When entering a number, the LEFT ARROW will erase the most recently entered digit.

- **Right Arrow** – The RIGHT ARROW key selects a program option and steps through display status information.

2.2.2 Displays

There are two types of displays: displays which present information about the sampler's status and displays which prompt for input.

- **Informational Displays** – Informational displays communicate information about the sampler's status. For example, when a sampling program is finished, a display communicates: "DONE," the number of samples taken, and the current time and date.
- **Input Displays** – Input displays can be identified easily because they contain a blinking word or number. The blinking word or number serves as a prompt for input and is said to be "selected." Nearly all input displays have a number assigned to them. The number is used to cross-reference the input displays with a explanatory listing found in Appendix A at the back of this guide. Access a display's number by pressing the STOP key.

There are two types of input displays: displays which prompt you for a choice and displays which prompt for numeric input.

- **Displays With Choices** – In an input display prompting for a choice, the blinking word indicates the currently

selected choice. If the blinking word is acceptable, press the ENTER/PROGRAM key. If the blinking word is not acceptable, press the LEFT ARROW or RIGHT ARROW key until the preferred choice is blinking, then press the ENTER/PROGRAM key.

- **Numeric Input Displays** – A numeric input display prompts for input by blinking the currently stored number. If the blinking number is acceptable, press the ENTER/PROGRAM key. To enter a new number, press the appropriate numeric keys followed by the ENTER/PROGRAM key. The sampler will not accept a number that exceeds the range of values placed in parentheses. If an entered number exceeds the range, the sampler will beep and the original number will reappear. Enter a new number.

Editing Numbers

The LEFT ARROW and CLEAR ENTRY key edit numeric entries if used *after* you press a numeric key and *before* you press the ENTER/PROGRAM key to store the number. The CLEAR ENTRY key clears any typed number and the original number will reappear. The LEFT ARROW erases the most recently typed number.

Some numeric input displays prompt for multiple values: hours, minutes, day, month, and year. The LEFT ARROW key and RIGHT

ARROW keys move back and forth between each of the five entries. Pressing the RIGHT ARROW or ENTER/PROGRAM key on the last entry will store the values and advance to the next display. Enter times in 24-hour format; enter dates in European format: DD-MMM-YY.

2.3 Programming Procedures

The procedure for programming the sampler in extended mode is slightly different than the procedure used to program the sampler in the basic mode. Differences are noted by placing the extended mode procedure in *italics*. When programming the sampler in the extended mode, follow the basic procedure, modifying it according to the noted differences. Two programming examples are included at the end of the procedure.

Procedure

1. Identify the number and size of the bottles.
Determine the inside diameter, type, and length of the suction line. Convert the sampler for composite sampling, if necessary.
2. Turn the sampler on with the ON/OFF key.
The “STANDBY” message will appear. If the sampler were turned off while running a routine, the “PROGRAM HALTED” message will be displayed. Both messages indicate the sampler is in standby.
3. Check the configuration settings.

- a. From standby, press the ENTER/PROGRAM key to access the interactive state.
 - b. Select “CONFIGURE” to access the configure sequence.
 - c. Press the LEFT ARROW or RIGHT ARROW key at the “SELECT OPTION” displays to scroll through the list of options without viewing each input display. To access a configure-option input display, press the ENTER/PROGRAM key at the option name.
 - d. Check the Bottle Size and Suction Line configure option settings. The settings must match the bottle and suction line identified in step 1.
 - e. Select “BASIC” or “EXTENDED” in the Programming Mode configure option.
 - f. Revise other configure option settings as needed.
 - g. Press the EXIT PROGRAM keys to return to standby.
4. From standby, press the ENTER/PROGRAM key to access the interactive state. Select “PROGRAM” to access the program sequence.

 **Note**

If you want to return to a previous display while programming, press the EXIT PROGRAM key. The sampler will return to standby. Press the

ENTER/PROGRAM key until you locate the display in question.

5. Enter the Sample Pacing settings. Select either time- or flow-pacing. Then, enter the time or flow pulse interval between samples.

IN THE EXTENDED MODE

Select time, flow, or Storm pacing. If you select time pacing, you will be prompted to select one of two types of time pacing: uniform or nonuniform. Select Uniform to pace the sampler at regular intervals; enter the time interval. Select Nonuniform to pace the sampler at irregular intervals. If you have configured the sampler for Clock Time intervals, enter specific times and dates for each sample event. If you have configured the sampler for Minutes, enter the quantity of samples at each interval. If you select flow-pacing, the next display will prompt you for the pulse interval.

If you select Storm pacing, the next display will prompt you for the delay to the first group sample. The Storm programming sequence is divided into two sections. The first section determines the settings for the first bottle group; the second section contains the settings for the second bottle group. Each section requires separate settings for the delay to the first sample of each group, the sample volume, and sample distribution. The first bottle group always receives

time-paced samples. The second group can receive either time-paced or flow-paced samples, depending on your selection in the second section of the storm programming sequence. The Storm settings for volume and distribution are identical to those used in the basic and extended mode.

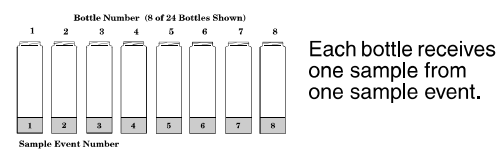
6. Enter the Sample Distribution settings. The first display of the Sample Distribution section asks if you want to multiplex samples. Select no for sequential sampling; the sampler will then prompt you for the Sample Volume settings. Select Yes for multiplexed sampling. The next display will prompt you to select either Bottles Per Sample or Samples Per Bottle. See Figure 2-1 for multiplexing types.

IN THE EXTENDED MODE

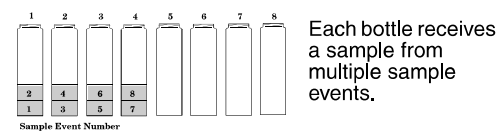
Entering the extended Sample Distribution setting requires three steps: 1) enter the number of bottles per sample event; 2) select the method used to switch bottles or sets. You can switch multiplexed bottles or bottle sets after a programmed time period (select Time) or after samples have been deposited (select Samples or Samples / bottle); 3) enter the number of samples to be deposited or the time period during which each bottle or set is to receive samples.

Follow the same procedure for storm-pacing. The sampler will prompt you for separate distribution settings for each section of the Storm sequence.

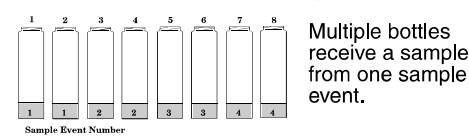
Sequential Sampling



Samples-per-bottle Multiplexing



Bottles-per-sample Multiplexing



Multiple Bottle Compositing

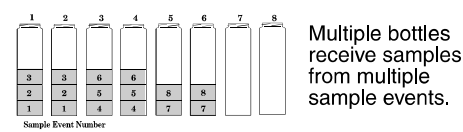


Figure 2-1 Sample Distribution Diagrams

7. Enter the Sample Volume settings. Because the programmed sample volume is a “nominal” value, enter a volume somewhat less than the capacity of the bottle to minimize the effects of cumulative error.

If bottles-per-sample multiplexing is being used to add preservatives to a bottle set, take the volume of the preservative into account.

The sampler can be configured through the Liquid Detector configure option to add the suction head input display to the program sequence. This display follows the sample volume input display.

 **Note**

Under most conditions, you should not need to use the suction head setting. This allows the liquid detector to determine the operating suction head each time a sample is taken, allowing the sampler to deliver consistently accurate samples in varying head conditions.

When the head is unknown or variable, always omit the suction head setting. Omit the head setting with the following selections in the Liquid Detector configure option: enable the detector (Display 240) and do not enter the head manually (Display 242).

To calibrate the sample volume, select “ENABLE” in the Calibrate Sampler configure option. The calibration displays follow the sample volume displays (and the suction head settings, if used).

8. Enter the Key Times settings. You will be asked if you want to enter a start time for the routine. If you select "YES," you will be prompted for the start time and date. If you select "NO," the sampler will use the start time delay.

IN THE EXTENDED MODE

The Stops and Resumes settings are available only when you have enabled the Sampling Stop/Resume configure option. The Stops and Resumes settings follow the start time settings. When entering Stop/Resume settings, first enter the number of stops and resumes, from 0 to 24. (Enter "0" if you want to omit the settings without disabling the Stops/Resumes option in the configure sequence.) Next, enter the stop and resume clock times. The first entry will be a stop time.

9. The sampler will automatically return to standby. Press START SAMPLING to start the routine. Press Start Sampling to start the routine. Enter the starting bottle number. If you make no response within 60 seconds, the sampler automatically begins with bottle 1. If you start the routine after the programmed start time, the sampler will allow you to enter a new start time.
10. Use the run state displays to monitor the sampler's progress. Examples 2-4 through 2-6 list the run state displays.

Example 2-1 Time Paced Programming

This example uses the Basic Programming mode to program the sampler for time paced sampling. The programming steps instruct the sampler to collect a sample four times every hour and deposit four samples in each bottle.

1.

. . . STANDBY . . .
 10:34:50 19-APR-

 Press Enter/Program to enter the interactive state.
2.

[PROGRAM, CONFIGURE]
 SAMPLER

 Select "Program" to access the program sequence.
3.

[TIME, FLOW]
 PACED SAMPLING

 Select "Time."
4.

SAMPLE EVERY
 0 HOURS, 1 MINUTES

 Enter "0" to set the hours at zero. Press Enter/Program to store "0" and move to the minutes entry.
5.

SAMPLE EVERY
 0 HOURS, 15 MINUTES

 Enter "15" to set the minutes entry to 15.

**Example 2-1 Time Paced
Programming (Continued)**

6.

MULTIPLEX SAMPLES? [YES , NO]
--

Select "Yes" for samples-per-bottle multiplexing.
7.

[BOTTLES PER SAMPLE, SAMPLES PER BOTTLE]

Select "Samples Per Bottle."
8.

4 SAMPLES PER BOTTLE (1 - 50)

Enter "4" to set the number of samples per bottle to 4.
9.

SAMPLE VOLUMES OF 200 ml (10 - 990)

Enter the sample volume of "200" ml.
10.

ENTER START TIME? [YES , NO]

Select "Yes" so you can enter the specific start time.
11.

TAKE FIRST SAMPLE AT 6:00 20-APR-04

Enter the desired start time. For this example, the start time is 6:00 on April 20.

Example 2-1 Time Paced Programming (Continued)

12.

PROGRAMMING SEQUENCE
COMPLETE . . .

After this message is displayed briefly,
the sampler will automatically return to
the standby state.

13.

. . . STANDBY . . .
10:37:23 19-APR-04

To run the program, press the Start
Sampling key after the sampler is
installed.

14.

START SAMPLING
AT BOTTLE **1** (1-24)

To start the sampling routine with the first
bottle, accept the blinking "1" by pressing
the Enter/Program key. To start the
routine with another bottle, enter the
starting bottle number here.

Example 2-2 Calibration Procedure

This example demonstrates the method used to calibrate the sampler for a 200 ml sample volume. The Calibrate Sampler configure option must be enabled in the configure sequence before the calibration displays shown below will appear.

1.

STANDBY
9:34:50 19-APR-04

Press Enter/Program to access the interactive state.
2.

[PROGRAM, CONFIGURE]
SAMPLER

Access the program sequence by selecting "PROGRAM."
3.

[TIME, FLOW]
PACED SAMPLING

Step through the program until the "CALIBRATE SAMPLER?" input display appears.
4.

↓
↓

Other program sequence displays.
5.

CALIBRATE SAMPLER?
[YES, NO]

Select "YES."

Example 2-2 Calibration Procedure (Continued)

6.

PRESS MANUAL SAMPLE
KEY WHEN READY . . .

Before pressing the Manual Sample key, make sure a collection container is underneath the pump tube.
7.

. . . MANUAL SAMPLE . . .
PUMPING 200 ml

The sampler will deliver the programmed sample volume.
8.

200 ml VOLUME
DELIVERED

Measure the actual volume delivered and enter that value here.
9.

CALIBRATE SAMPLER?
[YES, **NO**]

Repeat the procedure if desired or select "NO."
10.

↓
↓

Other program sequence displays.
11.

. . . STANDBY . . .
9:39:50 19-APR-04

The sampler will return to standby. Press the Start Sampling key to run the program.

Example 2-3 Composite Sampling

This example uses the Basic Programming mode to program the sample for composite sampling. The programming steps instruct the sampler to collect a sample four times every hour and deposit all samples in a single bottle.

1.

STANDBY
10:38:50 19-APR-04

Press the Enter/Program key to access the interactive state.
2.

[PROGRAM, CONFIGURE]
SAMPLER

Select "Program" to access the program sequence.
3.

[TIME, FLOW]
PACED SAMPLING

Select "Time."
4.

SAMPLE EVERY
0 HOURS, 1 MINUTES

Enter "0" to set the hours at zero. Press Enter/Program to store the number "0" and move to the minutes entry.
5.

SAMPLE EVERY
0 HOURS, 15 MINUTES

Enter "15" to set the minutes entry to 15.

Example 2-3 Composite Sampling (Continued)

6.

48 COMPOSITE
SAMPLES (0-200)

 Enter the number of samples to be collected: "48."
7.

SAMPLE VOLUMES OF
250 ml EACH (10 - 310)

 Enter the sample volume: "250."
8.

ENTER START TIME?
[**YES**, NO]

 Select "Yes" to enter the start time for the routine.
9.

TAKE FIRST SAMPLE AT
6:00 20-APR

 Enter the start time and date: 6:00 on April 20.
10.

PROGRAMMING SEQUENCE
COMPLETE . . .

 After this message is displayed briefly, the sampler will automatically return to the standby state.
11.

. . . STANDBY . . .
10:40:23 19-APR-04

 After the sampler is properly installed, press the Start Sampling key to run the program.

2.4 Foreign Language Displays and Metric Units of Measure

The sampler presents displays in English, Spanish, French, and German. Samplers presenting Spanish, French, and German displays support metric units for suction line and suction head measurements. Samplers operating with English displays support either English or metric units for line and head measurements. (Sample volumes are always entered in milliliters).

To program the sampler for foreign language displays, place the sampler in standby. Then, press STOP five times. The standby display will be replaced by an input display with these options: [English, German, Spanish, French]. Select the preferred language from this display. If you select Spanish, French, and German, the sampler will automatically convert English units of measure to metric units and return to standby. If you select English, a second display will appear. Select English or metric units of measure from this display. The sampler will convert the units of measure as required and return to standby.

2.5 Standby State

This section discusses the displays and messages used in the standby state.

2.5.1 Start Sampling After Program Halted

Halt a running program with the STOP or EXIT PROGRAM key. "PROGRAM HALTED" will be displayed to notify you of the halt status. Start the program again with the START SAMPLING key; the sampler will ask you to start the program from the beginning or to resume the program from the point at which it halted. Select "START" to start from the beginning. ("START" will re-initialize the display status memory.) Select "RESUME" to resume the program from the point at which it halted. If you make no selection within 60 seconds, the sampler will automatically select the currently blinking choice. The sampler can also be restarted with the RESUME key.

2.5.2 Done

The sampler will inform you it has completed a program by displaying "DONE." If a problem were encountered during the routine, one of two displays listed below may alternate with the "DONE" display.

Problem Occurred

The "PROBLEM OCCURRED" display indicates a missed sample. The sampler logs the probable cause in memory. This information is available through the display status procedure. Causes are listed in section 2.5.5.

Float Tripped

Samplers converted for composite sampling display the Float/weight Tripped message when the overflow float terminates the routine.

2.5.3 Display Status

Access a summary of the program settings and the results of the most recent sampling routine with the DISPLAY STATUS key. Display status information remains in memory until you start another program. If a sampling routine is in progress when you press the DISPLAY STATUS key, the sampling routine will be suspended until you exit Display Status.

If the pump count reaches the Tubing Life Warning setting, the Pump Tubing Warning will be displayed as soon as you press the DISPLAY STATUS key. The next display, "REVIEW PROGRAM," gives you three choices: "NO," "SETTINGS," and "RESULTS."

Select "NO" to return to the previous operating state. If you entered display status from the run state, the sampling routine will resume.

Select "SETTINGS" to view the program settings. Use the LEFT ARROW, RIGHT ARROW, and the ENTER/PROGRAM keys to scan the settings. When the RIGHT ARROW key or the ENTER/PROGRAM key is pressed at the last setting display, the "REVIEW PROGRAM" input display will reappear.

Select "RESULTS" to view the results of the sampling routine. Use the LEFT ARROW, RIGHT ARROW, and the ENTER/PROGRAM keys to scan the results. The results include: program start time and date, sample volume, source (see section 2.5.4), cause of any missed samples (see section 2.5.5), start time, number

of pump counts to liquid detection, pumping time, and time the routine was completed.

2.5.4 Source of Sample Event

Nine sources are reported:

- **Time** – The sample event was one of the program's time-paced samples.
- **Flow** – The sample event was one of the program's flow-paced samples.
- **Start** – The sample event occurred at the program's start time.
- **Resume** – The sample event compensated for a sample missed while the sampler was halted.
- **Power** – The sample event compensated for a missed sample missed while the sampler was without power.
- **Enable** – The sample event occurred when: the sampler became enabled by a device connected to pin F of the flow meter connector, or, at a programmed resume time.
- **Manual** – The sample event was initiated with the MANUAL SAMPLE key and was counted as one of the programmed sample events.
- **Time Switch** – The sample event was initiated at the programmed switch time.
- **Disable** – The sample event was initiated when: the sampler became disabled by a device connected to pin F of

the flow meter connector, or, at a programmed stop time.

2.5.5 Cause of Missed Samples

The probable cause of a missed sample follows the sample number/source display of the display status results. Twelve causes are reported:

- **Pump 'STOP' Key Hit** – The sampler was halted with the STOP key during the sample event.
- **Pump Jammed** – The sampler was unable to take the sample because the pump jammed.
- **Started Too Late** – This message is reported for all samples skipped because of an expired start time.
- **Program Halted** – The sample event was interrupted by the STOP or EXIT PROGRAM key.
- **Power Lost** – The sampler's power source was disconnected.
- **Sampler Inhibited** – The sampler was prevented from taking the sample by an inhibit signal sent to the sampler by the flow meter or Liquid Level Actuator.
- **Distributor Jammed** – The distributor jammed.
- **Probable Overflow** – Overflow is determined by multiplying the sample volume by the number of samples

deposited in a bottle and comparing the product to the volume of the bottle entered in the Bottle and Sizes configure option. If the product exceeds the bottle volume, no sample will be taken and the sampler will record the “Probable Overflow!” message.

- **Float/Weight Tripped** – Samplers converted for composite sampling display the Float Tripped message when the overflow float terminates the routine.
- **No More Liquid** – The sampler’s pump drained the flow stream before it delivered a full sample volume.
- **No Liquid Detected** – No liquid was detected.
- **Sampler Shut Off!** – The sampler was halted with the ON/OFF key during the sample event.

 Note

If the sampler misses a sample, it places an asterisk (*) in the lower right corner of the display.

2.6 Run State

A sampler in the run state is executing the sampler’s program. To start a sampling program and place the sampler into the run state, press the Start Sampling key. The sampler will present a number of displays which allow you to monitor the sampler’s progress. See Examples 2-4 through 2-6.

There are two instances where the sampler will enter the run state after the Start Sampling key is pressed, but will not begin the sampling program:

- If the sampler is acting as a slave in a Master/Slave pair, the slave will not begin the program until it receives an enable signal from the master. While waiting for the enable signal, the display will read “Master/Slave Mode...Waiting For Master.”
- If the sampler is interfaced with a flow meter, a Liquid Level Actuator, or other equipment capable of transmitting an inhibit signal, the sampler will not begin the program until the inhibit signal is suspended. The display will read Sampler Inhibited as long as it receives the inhibit signal.

Example 2-4 Run State Displays: Time Paced Sampling

1.

BOTTLE 5
AT 5:44 5:42:33

Indicates the bottle number of the next sequential sample. The second line reports the scheduled sample event time followed by the current time.

2.

BOTTLES 1- 4
AT 6:00 5:55:33

Indicates the scheduled time and receiving bottle numbers for an upcoming sample event. The program requires 4 bottles/sample event.

3.

1 OF 4, BOTTLE 1
AT 6:00 5:55:33

Indicates the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number. The program requires 4 samples/bottle.

4.

1 OF 4, BTLS 1- 4
AT 6:00 5:55:33

Indicates the sample and bottle numbers of the next sample event. The bottle set has 4 bottles.

**Example 2-4 Run State Displays:
Time Paced Sampling (Continued)**

5.

SAMPLE 3, BOTTLE 1
AT 6:00 5:42:33

Indicates the sample and bottle number of the next sample event. The current time is shown in the lower right corner. The program requires 1 bottle/sample event. Bottles be switched on a time basis. Alternates with the display in 6.
6.

NEXT BOTTLE CHANGE
AT 10:00 19-APR

Indicates the time of the next bottle switch.
7.

SAMPLE 2, BTLS 1 - 4
AT 6:00 5:42:33

Indicates the sample and bottle numbers of the next sample event. The current time is shown in the lower right corner. The program requires 4 bottles/sample event. Sets are switched on a time basis. Alternates with the display in 8.
8.

NEXT SET CHANGE
AT 8:00 19-APR

Indicates the time of the next bottle set switch.
9.

BOTTLE 1
PUMPING 200 ml

Indicates a sample in progress.

Example 2-5 Run State Displays: Flow Paced Sampling

1.

START AT 6:00	19-APR
5:42:43	19-APR

Indicates the programmed start time of a flow-paced sampling program when no sample is to be taken at the start time. The first line reports the programmed start time, the second line reports the current time and date.

2.

BOTTLE 1	
AT 6:00	5:42:33

Indicates the programmed start time of a flow-paced sampling program when a sample is to be taken at the start time. The current time is shown in the lower right corner.

3.

BOTTLE 1	
AFTER	5 PULSES

Indicates the bottle number of the next sequential sample. The second line reports the number of flow pulses remaining until the next sample event.

4.

BOTTLES 5- 7	
AFTER 25 PULSES	

Indicates the bottles which will receive samples at the next sample event. The second line reports the pulses remaining until the next sample event.

Example 2-5 Run State Displays: Flow Paced Sampling (Continued)

5.

1 OF 4, BOTTLE 1 AFTER 10 PULSES

Indicates the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number.

6.

1 OF 4, BTLS 1- 4 AFTER 1000 PULSES
--

Indicates the sample and bottle numbers of the next sample event. The bottle set consists of 4 bottles. The program requires 4 samples be placed in each bottle of the set.

7.

SAMPLE 2, BOTTLE 1 AFTER 10 PULSES

Indicates the sample and bottle number of the next sample event. The program requires 1 bottle/sample event. Bottles are switched on a time basis. Alternates with the display in 8.

8.

NEXT BOTTLE CHANGE AT 10:00 19-APR

Indicates the time of the next bottle switch.

**Example 2-5 Run State Displays:
Flow Paced Sampling (Continued)**

9.

SAMPLE 2, BTLS 1 - 4 AFTER 10 PULSES

Indicates sample and bottle numbers of the next sample. The program requires 4 bottles/sample event. Bottle sets are switched on a time basis. Alternates with the display in 10.
10.

NEXT SET CHANGE AT 10:00 19-APR

Indicates the time of the next bottle set switch.
11.

BOTTLE 1 PUMPING 200 ml

Indicates a sample in progress.

Example 2-6 Run State Displays: Composite Sampling

1.

SAMPLE 1 OF 12
AT 6:00 5:43:33

Indicates the sample number of the next sample and the total number of samples. The current time is shown in the lower right corner.
2.

SAMPLE 1 OF 12
AFTER 10 PULSES

Indicates the sample number of the next sample and the total number of samples required. The number of pulses to the next sample appears on the bottom line.
3.

BOTTLE 1
PUMPING 200 ml

Indicates a sample in progress.

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Section 3 Service

3.1 Cleaning the Suction Line and Bottles

Clean the suction line and pump tubing by placing the end of the suction line in a cleaning solution and pumping this solution through the tubing using the pump forward and pump reverse keys. Follow with a clean water rinse. Wash the glass bottles with a brush and soapy water, a dishwasher, or use an autoclave. The plastic bottles and lids can be washed in a dishwasher but cannot be autoclaved.

3.2 Pump Tubing



WARNING

Disconnect power before replacing the pump tubing. The pump is extremely powerful. If the sampler activates the pump while you are manipulating the tubing, you can be seriously injured.

To remove the pump tubing:

1. Disconnect power.
2. Detach the outer case of the liquid detector by loosening the two thumbscrews. Pull the tubing away from the detector.
3. Remove the outer pump lid and pull the tubing from the pump. Rotate the pump rollers manually to help remove the tubing.

To install new pump tubing:

1. The pump tube is marked with two black bands. Facing the liquid detector, place the end band against the upper inlet of the detector and the inner band at the outlet. See Figure 3-1.

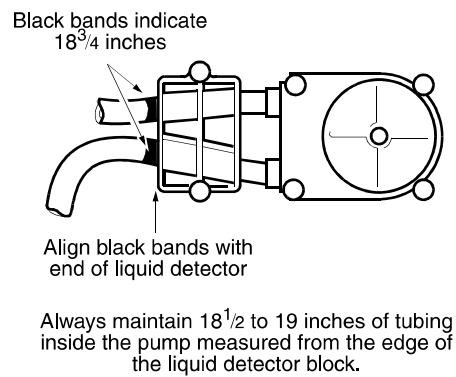


Figure 3-1 Pump Tube Installation

2. Replace the pump lid and the case of the liquid detector.

 **Note**

For proper operation of the liquid detector, tighten the detector's thumbscrews securely.

3. Feed the tube down through the center section, turn the center section over and pull the tube through the spring. Insert the tube into the distributor arm so that the end of the tube is flush with the end of the arm.
4. Reinstall the suction line and the distributor arm. Secure the distributor arm retaining nut. The exposed tube should continuously slope downward from the center section the distributor arm.
5. Reset the pump tube count in the Tubing Life configure option to zero.

3.3 Replacement of Suction Line

The vinyl suction line is removed from the pump tubing by detaching the tube coupling. The PTFE suction line is removed by loosening the clamp securing the line to the pump tube and pulling the suction line out of the pump tube. New line is attached by reversing this procedure.

3.4 Cleaning the Sampler

Clean the top cover, center section, and base section with warm soapy water or by spraying

them with a hose. Be sure a power source is attached to the 12 VDC connector and the flow meter connector is tightly capped.

3.5 Charging the Nickel-Cadmium Battery

Charge the Nickel-Cadmium Battery Pack with the Isco AC Power Pack or Isco Battery Charger. Connect the plug on the battery cable to the mating receptacle on the AC Power Pack or the Battery Charger. Charge the battery for 15 to 18 hours. While charging, the battery will feel cool to the touch. Discontinue charging when the battery temperature rises. Because a nickel-cadmium battery produces almost constant voltage, even under load, you cannot use voltage measurements to determine the charge. Repeated overcharging reduces the life of the battery.

3.6 Charging the Lead-Acid Battery

Charge the lead-acid battery with an Isco AC Power Pack. Measure the output voltage to determine the charge level of the lead-acid battery. A chart on the battery lists the charge level and the time required to recharge.

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Appendix A *Display Index*

A.1 Display Reference Index

The following pages list each input display in numeric order. Each display is accompanied by a brief explanation.

- | | |
|----|--|
| 1 | <p>[PROGRAM, CONFIGURE]
SAMPLER</p> |
| | <p>This display appears after you press the ENTER/PROGRAM key while in standby. Select "PROGRAM" to access the program sequence. Select "CONFIGURE" to access the configure sequence.</p> |
| 3 | <p>----- COUNTS FORWARD</p> |
| | <p>This display appears when you stop the pump with the STOP key after having pressed the PUMP FORWARD key. It reports the number of pump counts detected while the pump was in operation. Exit with any key except STOP and ON/OFF.</p> |
| 3 | <p>----- COUNTS REVERSE</p> |
| | <p>This display appears when you stop the pump with the STOP key after having pressed the PUMP REVERSE key. It reports the number of pump counts detected while the pump was in operation. Exit with any key except STOP and ON/OFF.</p> |
| 10 | <p>[TIME, FLOW]
PACED SAMPLING</p> |
| | <p>This display appears when you select "PROGRAM" in Display 1. Select "TIME" for time-paced sampling, or select "FLOW" for flow-paced sampling.</p> |

11	<div>[UNIFORM, NONUNIFORM] TIME INTERVALS</div> <p>This display appears only in the extended programming mode and follows Display 10 when you have selected "TIME." Select "UNIFORM" for uniform time intervals, "NONUNIFORM" for nonuniform intervals.</p>
12	<div>[TIME, FLOW, STORM] PACED SAMPLING</div> <p>This display appears only when the sampler is configured for the extended programming mode and for 4, 12, or 24 bottles. Select Time for time-paced sampling. Select Flow for flow-paced sampling, and Storm for storm sampling.</p>
14	<div>[TIME, FLOW] SECOND BOTTLE GROUP</div> <p>This display appears after you select Storm in Display 12. Use it to select time pacing or flow pacing for the second bottle group of a Storm routine.</p>
15	<div>-- MINUTE DELAY TO FIRST GROUP SAMPLE</div> <p>This display appears after you select "Storm" in Display 12. Enter the amount of time between the time the sampler is enabled and the first sample of the first bottle group.</p>

- | | |
|----|--|
| 16 | <p>[DURING, AFTER]
TIME MODE</p> |
| | <p>This display appears when you have selected "Flow" in Display 14. Select During to fill the first and second bottle groups concurrently. Select After to fill the second bottle group after the first bottle group.</p> |
| 17 | <p>-- MINUTE DELAY TO
SECOND GROUP SAMPLE</p> |
| | <p>This display appears after you select Storm in Display 12. Enter the amount of time between the time the sampler is enabled and the first sample event for the second bottle group.</p> |
| 20 | <p>MODIFY SEQUENCE?
[YES, NO]</p> |
| | <p>This display follows Display 11 when you have selected "NONUNIFORM." Select "YES" to modify the existing nonuniform intervals. Select "NO" to leave the nonuniform intervals unchanged.</p> |
| 21 | <p>SAMPLE EVERY
-- HOURS -- MINUTES</p> |
| | <p>In the basic programming mode, this display appears after you have selected "TIME" in Display 10. In the extended mode, this display appears when you have selected "UNIFORM" in Display 11. Enter the uniform time interval.</p> |

22	<div>SAMPLE EVERY ---- PULSES (1 - 9999)</div> <p>This display follows Display 10 when you have selected "FLOW." Enter the flow pulse interval.</p>
23	<div>TAKE -- TIMED SAMPLE EVENTS (1 - MAX)</div> <p>This display follows Display 15. Use this display to enter the number of sample events for the first bottle group in a Storm program.</p>
24	<div>SAMPLE INTERVALS OF -- MINUTES (1 - 999)</div> <p>This display follows Display 23. Enter the time interval between time paced sample events.</p>
25	<div>TAKE --- SAMPLES (1 - MAX)</div> <p>This display follows Display 20 when you have selected "YES" to modify the nonuniform time sequence. Enter the number of sample events. <i>MAX</i> varies with to the bottle size entered in Display 223.</p>
26	<div>TAKE SAMPLES AT 1. HH:MM DD-MMM</div> <p>This display follows Display 25. Enter the nonuniform clock times and dates for each sample event.</p>

- | | | |
|----|--|---|
| 27 | QUANTITY AT INTERVAL
1. -- AT --- MINUTES | <p>Enter the number of samples to be taken at each nonuniform minutes interval. The value entered will be one less than the total number of samples because the first sample, taken at the start time, counts as one.</p> |
| 30 | -- BOTTLES PER
SAMPLE EVENT (1 - MAX) | <p>This display appears for samplers configured for 24 bottles (Displays 221 or 222). Enter the number of bottles to receive a sample volume at each sample event.</p> |
| 31 | -- SAMPLES PER
BOTTLE (1 - MAX) | <p>In the basic mode, this display appears when you have selected Samples Per Bottle in Display 36. In the extended mode, it appears when the sampler is set up for one bottle set. Enter the number of samples to be deposited in each bottle.</p> |
| 35 | MULTIPLEX SAMPLES?
[YES, NO] | <p>Select Yes if you want the routine to perform bottles-per-sample or samples-per-bottle multiplexing. Select No if you want the routine to perform sequential sampling.</p> |

36	<div>[BOTTLES PER SAMPLE, SAMPLES PER BOTTLE]</div> <p>This display appears when you have selected Yes in Display 35. Select Bottles Per Sample for bottles-per-sample multiplexing. Select Samples Per Bottle for samples-per-bottle multiplexing.</p>
40	<div>CHANGE BOTTLES BASED ON [TIME, SAMPLES]</div> <p>This display appears in the extended mode when the number of bottles per sample event is 1. Select Time to switch bottles after a period of time. Select Samples to switch bottles after a number of samples have been deposited.</p>
41	<div>CHANGE SETS BASED ON [TIME, SAMPLES/BTL]</div> <p>Select Time to switch bottle sets after a specified period of time. Select Samples/Btl to switch bottle sets after a specified number of samples have been placed in a set of bottles.</p>
42	<div>CHANGE BOTTLES EVERY -- HOURS -- MINUTES</div> <p>This display appears after you select Time in Display 40. Enter the amount of time each bottle is to receive samples.</p>

- 43

CHANGE SETS EVERY -- HOURS -- MINUTES
--

This display appears after you select Time in Display 41. Enter the amount of time each bottle set is to receive samples.
- 44

CHANGE BOTTLES EVERY -- SAMPLES

This display appears after you select Samples in Display 40. Enter the number of samples each bottle is to receive.
- 45

CHANGE SETS EVERY _SAMPLES

This display appears after you select Samples/btl in Display 41. Enter the number of samples each bottle set is to receive.
- 46

FIRST BOTTLE CHANGE AT HH:MM DD-MM

This display appears when you have selected Yes in Display 95. Enter the time of the first bottle switch. The remaining bottle changes will occur according to settings entered in Display 42.
- 47

FIRST SET CHANGE AT HH:MM DD-MM

This display appears when you have selected Yes in Display 95. Enter the time of the first bottle set switch. The remaining bottle set changes will occur according to settings entered in Display 43.

48	<div>SAMPLE CONTINUOUSLY? [YES, NO]</div> <p>This display appears when the sampler is configured for 4, 12, or 24 bottles and when the sampler is programmed for time, nonuniform time, or flow pacing. Select "Yes" to sample continuously. Select "No" to stop the sampling routine after the sampler fills the last set of bottles.</p>
50	<div>SAMPLE VOLUMES OF --- ml EACH (10 - MAX)</div> <p>Enter the size of the sample volume. MAX will vary with the number of samples per bottle and bottle size.</p>
60	<div>--- COMPOSITE SAMPLES (0 - MAX)</div> <p>Enter the number of composite samples. Enter "0" to take samples until a float shut-off terminates the routine.</p>
70	<div>SUCTION HEAD OF -- FEET (1 - MAX)</div> <p>This display appears when you have selected "YES" in Display 242 or have selected "DISABLE" in Display 240. Enter the measured suction head. MAX will be the smaller of the suction line length or "20."</p>

80

CALIBRATE SAMPLE
VOLUME? [YES, NO]

This display appears in the program sequence when you have selected "ENABLE" in Display 290. Select "YES" to use the calibration sequence, "NO" to omit the calibration sequence.

81

PRESS MANUAL SAMPLE
KEY WHEN READY . . .

This display is part of the calibration sequence. Press the MANUAL SAMPLE key when a collection bottle is underneath the distributor and the suction line is in place.

82

--- m³ VOLUME
DELIVERED

This display is part of the calibration sequence. When it first appears, the blinking number reports the programmed sample volume. If the measured volume differs from the reported volume, enter the measured volume here.

83

---m³! ARE YOU
SURE? [YES, NO]

This display is part of the calibration sequence and appears if the measured volume and the programmed volume differ by a factor of two or more. Select "YES" to confirm the entry in Display 82. Select "NO" to return to Display 80.

90	<div>ENTER START TIME? [YES, NO]</div> <p>Select "YES" to enter a start time. Select "NO" to begin the sampling routine according to the delay entered in Display 310.</p>
91	<div>TAKE FIRST SAMPLE AT HH:MM DD-MMM</div> <p>This display appears when you have selected "YES" in Display 90. Enter the start time and date for the first sample event. This display will appear if you have started the routine after a programmed start time. Reenter the new start time.</p>
92	<div>START FLOW COUNT AT HH:MM DD-MMM</div> <p>This display appears when you have selected "YES" in Display 90. Enter the start time and date for the flow pulse countdown. This display appears when you have started the routine after a programmed start time. Reenter the new start time.</p>
93	<div>STORM ENABLED AFTER HH:MM DD-MM</div> <p>This display is the last display of the storm branch. It appears when you select Yes in Display 90. Enter the start time for the storm-sampling routine. The sampler will disregard enable or disable signals from the flow meter until the start time you enter here.</p>

95	<div>ENTER FIRST SWITCH TIME? [YES, NO]</div> <p>This display appears when you have selected Time in either Display 40 or 41. Select Yes to specify a clock time for the first bottle or bottle-set switch. Select No to begin the switch interval at the routine's start time.</p>
100	<div>-- STOP or RESUME TIMES (0 - 24)</div> <p>This display appears when you have selected "ENABLE" in Display 300. Enter the number of stop and resume times. Enter "0" to skip the stops and resumes settings without disabling the feature in the Stops/Resumes configure option.</p>
101	<div>STOP SAMPLING AT 1. HH:MM</div> <p>This display appears when the setting in Display 100 is greater than zero. Enter the appropriate stop time.</p>
102	<div>RESUME SAMPLING AT 1. HH:MM</div> <p>This display appears when the setting in Display 100 is greater than one. It follows Display 101. Enter the appropriate resume time.</p>

110	<div>MAX FLOW INTERVAL OF -- HOURS, -- MINUTES</div> <p>This display follows Display 22. Enter the maximum amount of time you want between flow-paced sample events in a storm program. If the time period is exceeded, the sampler will terminate the routine.</p>
140	<div>[START, RESUME] SAMPLING PROGRAM</div> <p>This display appears when a routine is halted and you press the start sampling key. Select "START" to start the sampling program at the beginning, "RESUME" to continue the sampling program from the point at which it was halted.</p>
141	<div>START SAMPLING AT BOTTLE -- (1 - MAX)</div> <p>This display appears after you start a routine and the sampler is configured for multiple bottles. Enter the starting bottle location for the sampling routine. Max varies according to number of bottles and the number of bottles per sample event.</p>
142	<div>CHANGE START TIME? [YES, NO]</div> <p>This display appears when you have started a routine after the programmed start time. Select Yes to enter a new start time. Select No to start the routine immediately.</p>

- | | |
|-----|---------------------------------|
| 143 | CHANGE START TIME?
[YES, NO] |
|-----|---------------------------------|
- This display appears when you have started a routine after the programmed start time. Select "YES" to enter a new start time. Select "NO" to start the routine immediately; some sample events may be missed or late.
- | | |
|-----|--|
| 148 | [REVIEW, PRINT]
PROGRAM INFORMATION |
|-----|--|
- Select "REVIEW" for the summary of the current program settings and for sampling results. Select "PRINT" to send the current status, program settings, and sampling results to an Isco Field Printer.
- | | |
|-----|--|
| 149 | PRINT PROGRAM [NO,
SETTINGS, RESULTS] |
|-----|--|
- This display appear after you select "Print" in Display 148. Select "NO" to return to standby. Select "Settings" to print the settings report. Select "RESULTS" to print the results report.
- | | |
|-----|---|
| 150 | REVIEW PROGRAM [NO,
SETTINGS, RESULTS] |
|-----|---|
- This display appears after you press DISPLAY STATUS. Select "NO" to return to the previous operating state. Select "SETTINGS" to view program settings. Select "RESULTS" to view the results completed when you pressed DISPLAY STATUS.

151	<div>SETTINGS DISPLAYS</div> <p>Display 151 is used to identify the displays used to summarize the current program settings which appear when you select “SETTINGS” in Display 150.</p>
152	<div>RESULTS DISPLAYS</div> <p>Display 152 is used to identify sampling results displays which appear when you select “RESULTS” in Display 150.</p>
200	<div>SELECT OPTION (←→) name of configure option</div> <p>Display 200 is used to identify the displays which identify each configure option. Press ENTER/PROGRAM to access the input displays for each option. Use the LEFT ARROW and the RIGHT ARROW keys to move through the options.</p>
210	<div>HH:MM MM/DD/YY HH:MM MM/DD/YY</div> <p>Set Clock configure option. Enter the time and date to set the controller's clock. Use military time. Note that the configure options does not use the European date format.</p>

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220	<div>[PORTABLE, REFRIG.] SAMPLER</div> <div>Bottle Size configure option. Select "PORTABLE" when you are using a 3710 Portable Sampler. Select "REFRIG." when you are using a 3710 refrigerated sampler.</div>
221	<div>[1, 2, 4, 8, 12, 24] BOTTLES</div> <div>Bottles and Sizes configure option. This display appears when you have selected Refrig. in Display 220. Select the number of bottles in the bottle base. Note that 12 bottle configuration is only available for the 3700FR.</div>
222	<div>[1, 4, 12, 24] BOTTLES</div> <div>Bottles and Sizes configure option. This display appears when you have selected Portable in Display 220. Select the number of bottles in the base.</div>
223	<div>BOTTLE VOLUME IS ----- ml</div> <div>Bottle Size configure option. Enter the bottle volume in milliliters.</div>
224	<div>---- ml . . . ARE YOU SURE? [YES, NO]</div> <div>Bottle Size configure option. This display appears when you have entered a bottle volume, in Display 223, that exceeds a standard Isco bottle size.</div>

230	<div>SUCTION LINE ID IS [1/4, 3/8] INCH</div> <p>Suction Line configure option. Select "1/4" if you are using 1/4 inch suction line, "3/8" if you are using 3/8 inch suction line.</p>
231	<div>SUCTION LINE IS [VINYL, PTFE]</div> <p>Suction Line configure option. This display appears when you have selected "3/8" in Display 230. Select "VINYL" if you are using vinyl suction line, "PTFE" if you are using PTFE suction line.</p>
232	<div>SUCTION LINE LENGTH IS -- FEET (3 - 99)</div> <p>Suction Line configure option. Enter the length of the suction line. The length should not include the tube coupling or the strainer.</p>
240	<div>[ENABLE, DISABLE] LIQUID DETECTOR</div> <p>Liquid Detector configure option. Select "ENABLE" to turn the detector on, "DISABLE" to turn the detector off. If you turn the detector off, you will be required to enter the suction head measurement (Display 70) in the program sequence.</p>

241	<div>- RINSE CYCLES (0 - 3)</div> <p>Liquid Detector configure option. This display appears when you have selected "ENABLE" in Display 240. Enter the number of rinse cycles. Rinse cycles condition the suction line to reduce cross contamination.</p>
242	<div>ENTER HEAD MANUALLY? [YES, NO]</div> <p>Liquid Detector configure option. This display appears when you have selected "ENABLE" in Display 240. Select "YES" to add the suction head setting (Display 70) to the program sequence. Select "NO" to omit the setting.</p>
243	<div>RETRY UP TO - TIMES WHEN SAMPLING (0 - 3)</div> <p>Liquid Detector configure option. This display appears when you have selected "ENABLE" in Display 240. Enter the number of retries: the number of times the sampler will try to detect the presence of liquid for each sample event.</p>
250	<div>[BASIC, EXTENDED] PROGRAMMING MODE</div> <p>Programming Mode configure option. Select "BASIC" if you want to use the basic programming mode. Select "EXTENDED" if you want to use the extended programming mode.</p>

255	<div>LOAD PROGRAM [#1, #2, #3, NONE]</div> <p>Load Stored Program configure option. Select the number of the sampling program you want to use. Select "NONE" to exit the display without loading a program.</p>
260	<div>SAVE PROGRAM AS [#1, #2, #3, NONE]</div> <p>Save Current Program configure option. Select the number you want to use to identify the current program with when saved. Select "NONE" to exit the display without saving a program.</p>
270	<div>TAKE SAMPLE AT START TIME? [YES, NO]</div> <p>Flow Mode Sampling configure option. This setting affects flow-paced sampling routines. Select "YES" to take the first sample at the start time, "NO" to take the first sample at the end of the first flow interval.</p>
271	<div>TAKE SAMPLE AT TIME SWITCH? [YES, NO]</div> <p>Flow Mode Sampling configure option. This setting affects flow-paced, time-switched sampling routines only. Select Yes to take a sample at switch times. Select No if no sample event is desired at the switch times.</p>

280	<div>ENTER INTERVALS IN [CLOCK TIME, MINUTES]</div> <p>Nonuniform Time configure option. Select "CLOCK TIME" to enter the nonuniform time intervals as clock times (Display 26). Select "MINUTES" to set the nonuniform intervals in minutes (Display 27).</p>
290	<div>[ENABLE, DISABLE] CALIBRATE SAMPLER</div> <p>Calibrate Sampler configure option. Select "ENABLE" to add the calibration sequence to the program sequence. Select "DISABLE" to omit the calibration sequence.</p>
300	<div>[ENABLE, DISABLE] SAMPLING STOP/RESUME</div> <p>Sampling Stop/Resume configure option. Select "ENABLE" to add the Sampling Stop and Resume settings to the program sequence. Select "DISABLE" to omit the settings.</p>
301	<div>SAMPLE AT STOP? [YES, NO]</div> <p>Sampling Stop/Resume configure option. This display appears when you have selected "ENABLE" in Display 300. Select "YES" to take a sample at stop times. Select "NO" if no sample event is desired at the stop times.</p>

302	<div>SAMPLE AT RESUME? [YES, NO]</div> <p>Sampling Stop/Resume configure option. This display appears when you have selected "ENABLE" in Display 300. Select "YES" to take a sample at the resume times. Select "NO" if no sample event is desired at the resume times.</p>
310	<div>---- MINUTES DELAY TO START (0 - 9999)</div> <p>Start Time Delay configure option. Enter the amount of time, in minutes, you want to delay the start time. This setting affects programs that do not have a programmed start time.</p>
320	<div>MASTER/SLAVE MODE? [YES, NO]</div> <p>Enable Pin configure option. Select "YES" to turn the Master/Slave mode on. Select "NO" to turn the Master/Slave mode off.</p>
321	<div>SAMPLE UPON DISABLE? [YES, NO]</div> <p>Enable Pin configure option. Select "YES" to take a sample at the time the sampler becomes inhibited. Select "NO" if no sample event is desired when the sampler becomes inhibited.</p>

- | | |
|-----|----------------------------------|
| 322 | SAMPLE UPON ENABLE?
[YES, NO] |
|-----|----------------------------------|
- Enable Pin configure option. Select "YES" to take a sample when the sampler becomes enabled. No sample will be taken if the signal initiates the start time delay countdown. Select "NO" to take no sample upon enable.
- | | |
|-----|-------------------------------------|
| 323 | RESET SAMPLE
INTERVAL? [YES, NO] |
|-----|-------------------------------------|
- Enable Pin configure option. Select "YES" to restart the sample interval countdown at the time the sampler becomes enabled. If "NO" is selected, the interval countdown is determined by the setting in Display 324.
- | | |
|-----|---------------------------------|
| 324 | INHIBIT COUNTDOWN?
[YES, NO] |
|-----|---------------------------------|
- Enable Pin configure option. This display appears when "NO" was selected in Display 323. Select "YES" to halt the pacing interval when the sampler is disabled. Select "NO" to continue the countdown.
- | | |
|-----|-------------------------------|
| 330 | [CONTINUOUS SIGNAL,
PULSE] |
|-----|-------------------------------|
- Event Mark configure option. Select "CONTINUOUS SIGNAL" to send a variable duration event mark signal out pin E of the flow meter connector. Select "PULSE" to send a 3 second event mark signal.

331	<div>DURING [PUMP CYCLE, FWD PUMPING ONLY]</div> <p>Event Mark configure option. Select "PUMP CYCLE" to send the signal continuously during the entire pump cycle. Select "FWD PUMPING ONLY" to send the signal while the pump is delivering a volume.</p>
332	<div>AT THE BEGINNING OF [PURGE, FWD PUMPING]</div> <p>Event Mark configure option. Select "PURGE" to transmit an event mark pulse signal to a flow meter at the beginning of the pre-sample purge. Select "FWD PUMPING" to transmit a pulse when the pump switches forward.</p>
340	<div>--- PRE-SAMPLE COUNTS (0 - 9999)</div> <p>Purge Counts configure option. Enter the number of pre-sample pump counts needed to purge the suction line. This value is set to 150 when the controller is re-initialized.</p>
341	<div>--- POST-SAMPLE COUNTS (0 - 9999)</div> <p>Purge Counts configure option. Enter the number of post-sample pump counts needed to purge the suction line. The number that initially appears is derived from the suction line ID and length entered in Displays 230 and 232.</p>

- 350

----- PUMP COUNTS,
WARNING AT -----
- Tubing Life configure option. This informational display reports the number of pump counts elapsed since the last reset and the number of counts required to trigger the Pump Tubing Warning. Exit this display by pressing any key.
- 351

RESET PUMP COUNTER?
[YES, NO]
- Tubing Life configure option. After changing the pump tube, select "YES" to reset the pump counter to zero. Select "NO" to leave the counter unchanged.
- 352

----- PUMP COUNTS
TO WARNING
- Tubing Life configure option. Enter the number of pump counts required to trigger the pump count warning. This value is reset to 500,000 when the controller is re-initialized.
- 360

[ENABLE, DISABLE]
PROGRAM LOCK
- Program Lock configure option. Select "ENABLE" to turn the program lock on: input displays will be protected by a pass-number: 3710. Select "DISABLE" to turn the program lock off.

365	<div>SAMPLER ID NUMBER IS -----</div> <p>Sampler ID configure option. Enter the ID for the sampler. Use any of the numeric keys. Press START SAMPLING for a space. Press RESUME SAMPLER for a period. Press MANUAL SAMPLE to enter a dash (-).</p>
370	<div>TEST DISTRIBUTOR? [YES, NO]</div> <p>Run Diagnostics configure option. Select Yes to run the distributor test. Select No to skip the test. The distributor is tested by moving it to position 24 then back to position 1.</p>
371	<div>RE-INITIALIZE? [YES, NO]</div> <p>Run Diagnostics configure option. Select "YES" to re-initialize the sampler. Select "NO" to the leave the controller unchanged.</p>

3700 Portable Sampler

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APPENDIX C

STANDARD OPERATING PROCEDURES



REMINDERS	OVERVIEW	INSTRUCTIONS		VISUALS
<p>Note: Pumps are tied to float switches and may not activate depending on the current level in the associated tanks.</p>	<p>1. Turn System On</p>	<p>1. <u>Turn system on.</u></p> <ol style="list-style-type: none"> Ensure all inline valves are in the open position Turn on main power switch Set sump pump 301 & 302 to 'Auto' Set transfer pump 303 & 304 to 'Auto' <p>2. <u>Turn System off</u></p> <ol style="list-style-type: none"> Set sump pump 301 & 302 to 'Off' Set transfer pump 303 & 304 to 'Off' Turn main power off <p>3. <u>Check Particulate Filter Differential Pressure</u></p> <ol style="list-style-type: none"> If the transfer pumps are not currently operating (e.g. transfer pump lights are off), switch transfer pumps 303 & 304 to 'Hand' to engage manual operation. The sump pumps do not need to be operating during this procedure. Ensure that the transfer pumps are operating and water is running through the system by checking the flow meter located on the effluent side of the carbon vessels. Document the influent pressure to the filtration units (Pressure gauges P2 & P3 and P8 & P9). Document the effluent pressure from the filtration units (pressure gauges P4 & P10). The difference between the influent pressure and the effluent pressure is the differential pressure. If this differential is greater than 15 psi, shut the system down and replace the filtration cartridges of the associated filtration unit. Once inspection is complete, set Transfer Pumps 303 & 304 to 'Auto' to resume normal running mode. <p>4. <u>Check Particulate Filter Differential Pressure</u></p> <ol style="list-style-type: none"> Turn system off (#2 above) and wait for pressure bleed valves to remove excess pressure from the system. Isolate the filtration housing to be changed by closing the inline isolation ball valves on either side of the unit. Check the pressure gauge on top of the filtration housing. If the pressure is greater than zero, bleed off excess pressure by slowly opening up drain valve on the side of the filter unit. Once filter pressure reads zero, the unit may be serviced per the manufacturer's instructions. (See O&M Manual) Turn system on (#1 above) <p>5. <u>Check Carbon Filtration Pressure</u></p> <ol style="list-style-type: none"> If the transfer pumps are not currently operating (e.g. transfer pump lights are off), switch Transfer Pumps 303 & 304 to 'Hand' to engage manual operation. The sump pumps do not need to be operating during this procedure. Ensure that the transfer pumps are operating and water is running through the system by checking the flow meter located on the effluent side of the carbon vessels. Document the primary carbon influent pressures (Pressure gauges P5 & P11). Document the secondary carbon influent pressures (Pressure gauges P6 & P12). If either the primary or secondary carbon influent pressure gauges read greater than 12 psi, refer to the troubleshooting section of the O&M Manual. Either the influent flow rate to the carbon vessels needs to be reduced or the vessels need to be back flushed. Once inspection is complete, set Transfer Pumps 303 & 304 to 'Auto' to resume normal running mode. 		
<p>Note: Ensure that all lock out/tag out procedures are followed prior to working on any electrical equipment.</p>	<p>2. Turn System Off</p>			
	<p>3. Check Particulate Differential Pressure</p>			
	<p>4. Check Particulate Filter differential pressure.</p>			
	<p>5. Check Carbon Filtration Pressure</p>			
Reference Documents	O & M Manual		Related Procedures	

APPENDIX D

CARBON SYSTEM SPECIFICATIONS

Cartridge Filter Housings

These cartridge filters offer a wide range of flow capacities and contaminant holding capabilities. The housings can accommodate from 1 to 205 cartridges around. All housings can be supplied with an ASME code stamp, if required.

Standard Features

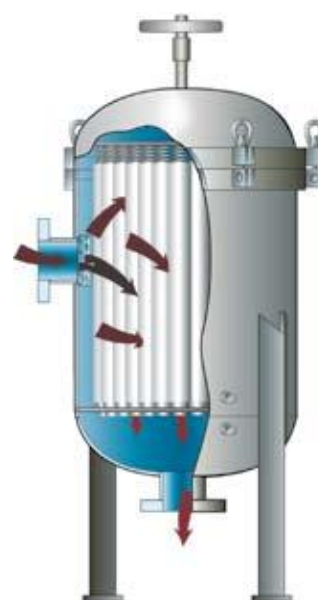
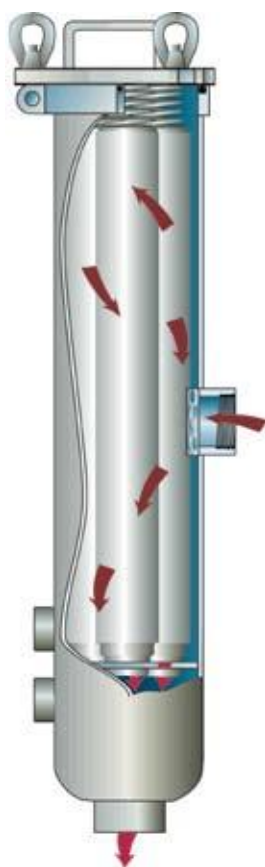
- Low pressure drop
- Permanently piped housings are opened without special tools and without disturbing the piping
- Machined cover gasket groove provides positive O-ring sealing
- Easy to clean
- In-line inlet and outlet
- Stainless steel internals

Standard Options

- 2 outlet styles
- Carbon steel, 304 or 316 stainless steel housings
- ASME code stamp
- O-ring seals: Buna N, EPR, Viton®, Teflon®
- Accommodates 10, 20, 30 or 40-inch cartridges
- Flanged connections for 3/4 through 12-inch pipe
- V posts or threaded center posts
- Units accept DOE or 222 style cartridges

How They Work

Unfiltered fluid enters the housing and is distributed evenly around the cartridges, from outside to inside. Solids are collected on the outside for easy removal. The filtered fluid then exits through the outlet pipe.



Center: Models 4, 6 and 8
Bottom Right: Models 12 thru 48

Cartridge Requirements

The following table gives the number of cartridges needed for each housing model.

Model Number and Diameter	Cartridge Lengths	Number of Cartridges	Equivalent 10-inch lengths	Available Pipe Sizes
Model 4	10-inch	1	1	3/4, 1, 1-1/4, 1-1/2, 2
	20-inch	1	2	
	30-inch	1	3	
	40-inch	1	4	
Model 6	20-inch	3	6	3/4, 1, 1-1/4, 1-1/2, 2, 3
	30-inch	3	9	
	40-inch	3	12	
Model 8	20-inch	6	12	3/4, 1, 1-1/4, 1-1/2, 2, 3
	30-inch	6	18	
	40-inch	6	24	
Model 12	20-inch	12	24	2,3,4
	30-inch	12	36	
	40-inch	12	48	
Model 16	20-inch	20	40	2,3,4
	30-inch	20	60	
	40-inch	20	80	
Model 18	20-inch	27	54	2,3,4
	30-inch	27	81	
	40-inch	27	108	
Model 22	20-inch	40	80	3,4,6
	30-inch	40	120	
	40-inch	40	160	
Model 24	20-inch	52	104	3,4,6
	30-inch	52	156	
	40-inch	52	208	
Model 30	20-inch	82	164	4,6,8
	30-inch	82	246	
	40-inch	82	328	
Model 36	20-inch	116	232	6,8,10
	30-inch	116	348	
	40-inch	116	464	
Model 42	20-inch	158	316	8,10,12
	30-inch	158	474	
	40-inch	158	632	
Model 48	20-inch	205	410	8,10,12
	30-inch	205	615	
	40-inch	205	820	

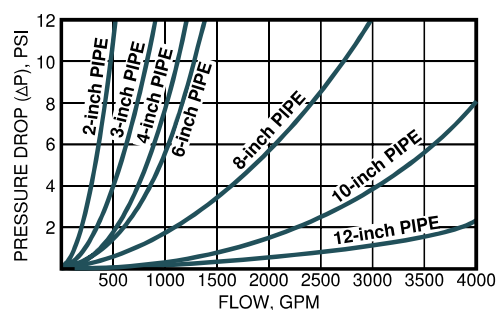
Determining Housing Pressure Drop Only

The pressure drops shown on the graph are reliable for all cartridge housings. The pressure drop of any housing is governed by the size of the inlet and outlet, not the vessel itself.

1. Using desired pipe size and approximate flow rate, determine the basic pressure drop from the graph.
2. Multiply the pressure drop obtained in step 1 by the viscosity correction factor found in the accompanying table.
3. You now have the pressure drop for an empty cartridge housing.
4. The user selected cartridge pressure drop must then be added to the housing pressure.
5. To calculate pressure drop through cartridges, see page 166.

Viscosity Factors

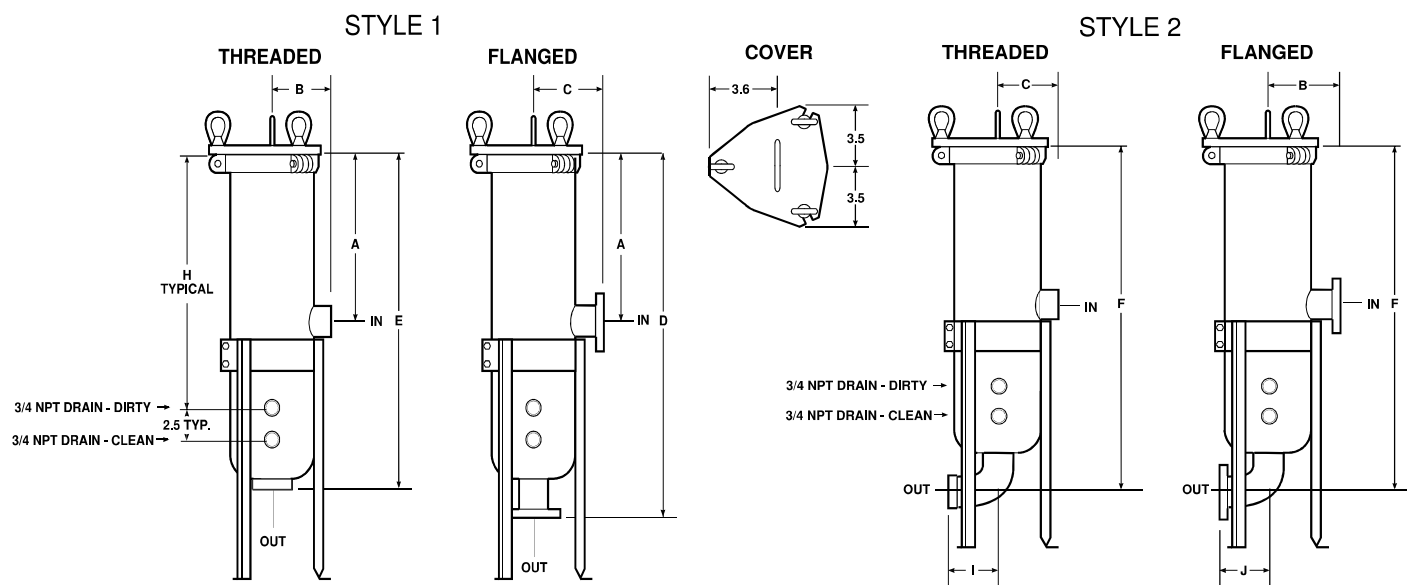
	CPS NUMBER							
1 (H ₂ O)	50	100	200	400	600	800	1000	2000
.65	.85	1.00	1.10	1.20	1.40	1.50	1.60	1.80



*Based on housing only. Fluid viscosity, filter cartridge used, and expected dirt loading should be considered when sizing a filter.



Dimensions for Models 4, 6, and 8 (IN)



Model No.	Pipe Size	A	B	C	D	E	F	H	I	J
4110	3/4	6.0	5.0	3.5	20.0	18.6	18.9	11.8	1.9	4.0
	1	6.0	5.0	3.5	20.0	18.8	19.3	11.8	2.5	4.0
	1-1/4	6.0	5.0	3.5	20.0	18.8	19.7	11.8	2.9	4.0
	1-1/2	6.0	5.0	3.5	20.0	18.8	20.1	11.8	3.3	4.0
	2	6.0	5.0	3.5	20.0	18.7	20.8	11.8	4.0	5.0
4120	3/4	11.0	5.0	3.5	30.0	28.6	28.9	21.8	1.9	4.0
	1	11.0	5.0	3.5	30.0	28.8	29.3	21.8	2.5	4.0
	1-1/4	11.0	5.0	3.5	30.0	28.8	29.7	21.8	2.9	4.0
	1-1/2	11.0	5.0	3.5	30.0	28.8	30.1	21.8	3.3	4.0
	2	11.0	5.0	3.5	30.0	28.7	30.8	21.8	4.0	5.0
4130	3/4	16.0	5.0	3.5	40.0	38.6	38.9	31.8	1.9	4.0
	1	16.0	5.0	3.5	40.0	38.8	39.3	31.8	2.5	4.0
	1-1/4	16.0	5.0	3.5	40.0	38.8	39.7	31.8	2.9	4.0
	1-1/2	16.0	5.0	3.5	40.0	38.8	40.1	31.8	3.3	4.0
	2	16.0	5.0	3.5	40.0	38.7	40.8	31.8	4.0	5.0
4140	3/4	21.0	5.0	3.5	50.0	48.6	48.9	41.8	1.9	4.0
	1	21.0	5.0	3.5	50.0	48.8	49.3	41.8	2.5	4.0
	1-1/4	21.0	5.0	3.5	50.0	48.8	49.7	41.8	2.9	4.0
	1-1/2	21.0	5.0	3.5	50.0	48.8	50.1	41.8	3.3	4.0
	2	21.0	5.0	3.5	50.0	48.7	50.8	41.8	4.0	5.0

Dimensions are reference only and should not be used for hard plumbing. Consult factory for certified drawings.

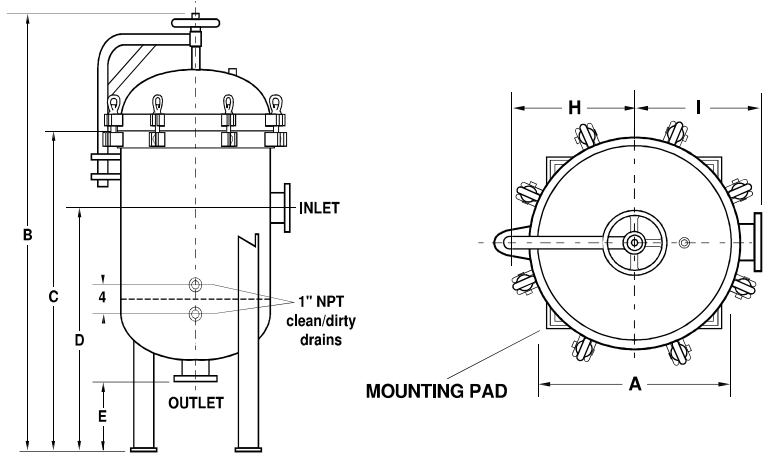


Dimensions for Models 4, 6, and 8 (IN) Cont.

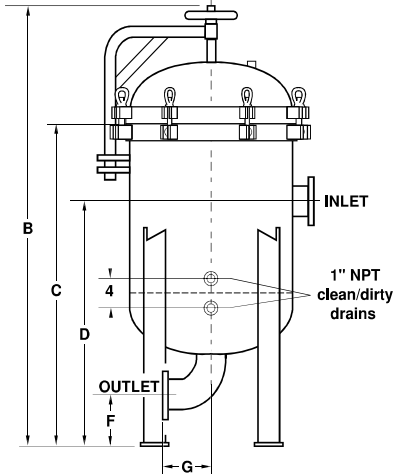
Model No.	Pipe Size	A	B	C	D	E	F	H	I	J
6310	3/4	6.0	6.0	4.0	21.0	18.7	18.9	11.8	1.9	5.0
	1	6.0	6.0	4.3	21.0	18.8	19.3	11.8	2.5	5.0
	1-1/4	6.0	6.0	4.3	21.0	18.8	19.7	11.8	2.9	5.0
	1-1/2	6.0	6.0	4.3	21.0	18.8	20.1	11.8	3.3	5.0
	2	6.0	6.0	4.3	21.88	18.8	20.8	11.8	4.0	5.0
	3	6.0	6.0	4.3	21.88	19.1	22.1	11.8	6.1	7.3
6320	3/4	11.0	6.0	4.0	31.0	28.7	28.9	21.8	1.9	5.0
	1	11.0	6.0	4.3	31.0	28.8	29.3	21.8	2.5	5.0
	1-1/4	11.0	6.0	4.3	31.0	28.8	29.7	21.8	2.9	5.0
	1-1/2	11.0	6.0	4.3	31.0	28.8	30.1	21.8	3.3	5.0
	2	11.0	6.0	4.3	31.88	28.7	30.8	21.8	4.0	5.0
	3	11.0	6.0	4.3	31.88	29.1	32.1	21.8	6.1	7.3
6330	3/4	16.0	6.0	4.0	41.0	38.7	38.9	31.8	1.9	5.0
	1	16.0	6.0	4.3	41.0	38.8	39.3	31.8	2.5	5.0
	1-1/4	16.0	6.0	4.3	41.0	38.8	39.7	31.8	2.9	5.0
	1-1/2	16.0	6.0	4.3	41.0	38.8	40.1	31.8	3.3	5.0
	2	16.0	6.0	4.3	41.88	38.8	40.8	31.8	4.0	5.0
	3	16.0	6.0	4.3	41.88	39.1	42.1	31.8	6.1	7.3
6340	3/4	21.0	6.0	4.0	51.0	48.7	48.9	41.8	1.9	5.0
	1	21.0	6.0	4.3	51.0	48.8	49.3	41.8	2.5	5.0
	1-1/4	21.0	6.0	4.3	51.0	48.8	49.7	41.8	2.9	5.0
	1-1/2	21.0	6.0	4.3	51.0	48.8	50.1	41.8	3.3	5.0
	2	21.0	6.0	4.3	51.88	48.8	50.8	41.8	4.0	5.0
	3	21.0	6.0	4.3	51.88	49.1	52.1	41.8	6.1	7.3
8620	3/4	11.0	7.5	5.3	32.1	29.7	30.1	21.8	1.9	5.0
	1	11.0	7.5	5.3	32.1	29.8	30.4	21.8	2.5	5.0
	1-1/4	11.0	7.5	5.3	32.1	29.8	30.7	21.8	2.9	5.0
	1-1/2	11.0	7.5	5.6	32.1	29.8	30.1	21.8	3.3	5.0
	2	11.0	7.5	5.8	32.1	29.8	31.8	21.8	4.0	5.0
	3	11.0	7.5	6.8	32.4	30.3	33.2	21.8	6.1	7.3
8630	3/4	16.0	7.5	5.3	42.1	39.7	40.1	31.8	1.9	5.0
	1	16.0	7.5	5.3	42.1	39.8	40.4	31.8	2.5	5.0
	1-1/4	16.0	7.5	5.3	42.1	39.8	40.7	31.8	2.9	5.0
	1-1/2	16.0	7.5	5.6	42.1	39.8	40.1	31.8	3.3	5.0
	2	16.0	7.5	5.8	42.1	39.8	41.8	31.8	4.0	5.0
	3	16.0	7.5	6.8	42.4	40.3	43.2	31.8	6.1	7.3
8640	3/4	21.0	7.5	5.3	52.1	49.7	50.1	41.8	1.9	5.0
	1	21.0	7.5	5.3	52.1	49.8	50.4	41.8	2.5	5.0
	1-1/4	21.0	7.5	5.3	52.1	49.8	50.7	41.8	2.9	5.0
	1-1/2	21.0	7.5	5.6	52.1	49.8	50.1	41.8	3.3	5.0
	2	21.0	7.5	5.8	52.1	49.8	51.8	41.8	4.0	5.0
	3	21.0	7.5	6.8	52.4	50.3	53.2	41.8	6.1	7.3

R **Dimensions for Models 12-24 (IN)**

STYLE 1



STYLE 2



Model No.	No. of Cart.	Cart. Length	Pipe Size	STYLE 1					STYLE 2							Empty Weight (lbs)	Total Volume (cu. ft.)
				A	B	C	D	E	B	C	D	F	G	H	I		
12	12	20	2	12.0	59.1	43.1	33.1	12.0	50.6	34.6	24.6	4.5	5.5	9.3	10.0	370	2.2
			3						52.9	36.9	26.9	5.3	7.3			385	
			4						55.1	39.1	29.1	6.0	9.0			410	
		30	2	12.0	69.1	53.1	38.1	12.0	60.6	44.6	29.6	4.5	5.5	9.3	10.0	395	2.9
			3						62.9	46.9	31.9	5.3	7.3			410	
			4						65.1	49.1	34.1	6.0	9.0			425	
		40	2	12.0	79.1	63.1	43.1	12.0	70.6	54.6	34.6	4.5	5.5	9.3	10.0	420	3.7
			3						72.9	56.9	36.9	5.3	7.3			435	
			4						75.1	59.1	39.1	6.0	9.0			455	
16	20	20	2	16.0	61.1	44.1	34.1	12.0	52.6	35.6	25.6	4.5	5.5	10.9	12.0	450	3.6
			3						54.9	37.9	27.9	5.3	7.3			465	
			4						57.1	40.1	30.1	6.0	9.0			480	
		30	2	16.0	71.1	54.1	39.1	12.0	62.6	45.6	30.6	4.5	5.5	10.9	12.0	475	4.8
			3						64.9	47.9	32.9	5.3	7.3			495	
			4						67.1	50.1	35.1	6.0	9.0			510	
		40	2	16.0	81.1	64.1	44.1	12.0	72.6	55.6	35.6	4.5	5.5	10.9	12.0	505	5.9
			3						74.9	57.9	37.9	5.3	7.3			520	
			4						77.1	60.1	40.1	6.0	9.0			540	

Dimensions are reference only and should not be used for hard plumbing. Consult factory for certified drawings.

H I G H < C A P A C I T Y C A R T R I D G E F I L T E R H O U S I N G


Dimensions for Models 12-24 (IN) Cont.

Model No.	No. of Cart.	Cart. Length	Pipe Size	STYLE 1					STYLE 2							Empty Weight (lbs)	Total Volume (cu. ft.)
				A	B	C	D	E	B	C	D	F	G	H	I		
18	27	20	2	18.0	62.1	44.6	34.6	12.0	53.6	36.1	26.1	4.5	5.5	11.9	13.0	480	4.7
			3						55.9	38.4	28.4	5.3	7.3			500	
			4						58.1	40.6	30.6	6.0	9.0			515	
		30	2	18.0	72.1	54.6	39.6	12.0	63.6	46.1	31.1	4.5	5.5	11.9	13.0	515	6.1
			3						65.9	48.4	33.4	5.3	7.3			530	
			4						68.1	50.6	35.6	6.0	9.0			550	
		40	2	18.0	82.1	64.6	44.6	12.0	73.6	56.1	36.1	4.5	5.5	11.9	13.0	550	7.6
			3						75.9	58.4	38.4	5.3	7.3			565	
			4						78.1	60.6	40.6	6.0	9.0			580	
22	40	20	2	22.0	64.1	45.6	35.6	12.0	55.6	37.1	27.1	4.5	5.5	13.9	15.0	615	7.3
			3						57.9	39.4	29.4	5.3	7.3			630	
			4						60.1	41.6	31.6	6.0	9.0			645	
			6						64.1	45.6	35.6	7.0	12.5			690	
		30	2	22.0	74.1	55.6	40.6	12.0	65.6	47.1	32.1	4.5	5.5	13.9	15.0	655	9.5
			3						67.9	49.4	34.4	5.3	7.3			670	
			4						70.1	51.6	36.6	6.0	9.0			690	
			6						74.1	55.6	40.6	7.0	12.5			730	
		40	2	22.0	84.1	65.6	45.6	12.0	75.6	57.1	37.1	4.5	5.5	13.9	15.0	695	11.7
			3						77.9	59.4	39.4	5.3	7.3			710	
			4						80.1	61.6	41.6	6.0	9.0			730	
			6						84.1	65.6	45.6	7.0	12.5			770	
24	52	20	2	24.0	65.1	46.1	36.1	12.0	56.6	37.6	27.6	4.5	5.5	14.9	16.0	665	8.8
			3						58.9	39.9	29.9	5.3	7.3			680	
			4						61.1	42.1	32.1	6.0	9.0			700	
			6						65.1	46.1	36.1	7.0	12.5			745	
		30	2	24.0	75.1	56.1	41.1	12.0	66.6	47.6	32.6	4.5	5.5	14.9	16.0	710	11.4
			3						68.9	49.9	34.9	5.3	7.3			725	
			4						71.1	52.1	37.1	6.0	9.0			740	
			6						75.1	56.1	41.1	7.0	12.5			790	
		40	2	24.0	85.1	66.1	46.1	12.0	76.6	57.6	37.6	4.5	5.5	14.9	16.0	750	14.0
			3						78.9	59.9	39.9	5.3	7.3			770	
			4						81.1	62.1	42.1	6.0	9.0			785	
			6						85.1	66.1	46.1	7.0	12.5			830	



Dimensions for Models 30-48 (IN)

Model No.	No. of Cart.	Cart. Length	Pipe Size	STYLE 1					STYLE 2							Empty Weight (lbs)	Total Volume (cu. ft.)
				A	B	C	D	E	B	C	D	F	G	H	I		
30	82	20	2	30.0	68.1	47.6	37.6	12.0	59.6	39.1	29.1	4.5	5.5	17.9	19.0	955	14.5
			3						61.9	41.4	31.4	5.3	7.3			970	
			4						64.1	43.6	33.6	6.0	9.0			990	
			6						68.1	47.6	37.6	7.0	12.5			1035	
			8						72.4	51.9	41.9	8.3	16.0			1100	
	30		2	30.0	78.1	57.6	42.6	12.0	69.6	49.1	34.1	4.5	5.5	17.9	19.0	1030	18.6
			3						71.9	51.4	36.4	5.3	7.3			1045	
			4						74.1	53.6	38.6	6.0	9.0			1060	
			6						78.1	57.6	42.6	7.0	12.5			1110	
			8						82.4	61.9	46.9	8.3	16.0			1170	
	40		2	30.0	88.1	67.6	47.6	12.0	79.6	59.1	39.1	4.5	5.5	17.9	19.0	1100	22.7
			3						81.9	61.4	41.4	5.3	7.3			1120	
			4						84.1	63.6	43.6	6.0	9.0			1135	
			6						88.1	67.6	47.6	7.0	12.5			1180	
			8						92.4	71.9	51.9	8.3	16.0			1245	
36	116	20	2	36.0	71.1	49.1	39.1	12.0	62.6	40.6	30.6	4.5	5.5	20.9	22.0	1315	22.0
			3						64.9	42.9	32.9	5.3	7.3			1330	
			4						67.1	45.1	35.1	6.0	9.0			1350	
			6						71.1	49.1	39.1	7.0	12.5			1395	
			8						75.4	53.4	43.4	8.3	16.0			1460	
			10						79.6	57.6	47.6	9.5	19.0			1570	
	30		2	36.0	81.1	59.1	44.1	12.0	72.6	50.6	35.6	4.5	5.5	20.9	22.0	1425	27.9
			3						74.9	52.9	37.9	5.3	7.3			1440	
			4						77.1	55.1	40.1	6.0	9.0			1460	
			6						81.1	59.1	44.1	7.0	12.5			1505	
			8						85.4	63.4	48.4	8.3	16.0			1570	
			10						89.6	67.6	52.6	9.5	19.0			1680	
	40		2	36.0	91.1	69.1	49.1	12.0	82.6	60.6	40.6	4.5	5.5	20.9	22.0	1535	33.8
			3						84.9	62.9	42.9	5.3	7.3			1550	
			4						87.1	65.1	45.1	6.0	9.0			1570	
			6						91.1	69.1	49.1	7.0	12.5			1615	
			8						95.4	73.4	53.4	8.3	16.0			1680	
			10						99.6	77.6	57.6	9.5	19.0			1790	
42	158	20	2	42.0	74.1	50.6	40.6	12.0	65.6	42.1	32.1	4.5	5.5	23.9	25.0	2030	31.6
			3						67.9	44.4	34.4	5.3	7.3			2045	
			4						70.1	46.6	36.6	6.0	9.0			2060	
			6						74.1	50.6	40.6	7.0	12.5			2110	

H I G H < C A P A C I T Y C A R T R I D G E F I L T E R H O U S I N G


Dimensions for Models 30-48 (IN) Cont.

Model No.	No. of Cart.	Cart. Length	Pipe Size	STYLE 1					STYLE 2							Empty Weight (lbs)	Total Volume (cu. ft.)
				A	B	C	D	E	B	C	D	F	G	H	I		
			8						78.4	54.9	44.9	8.3	16.0			2170	
			10						82.6	59.1	49.1	9.5	19.0			2280	
			12						87.1	63.6	53.6	11.0	22.5			2415	
	30	2		42.0	84.1	60.6	45.6	12.0	75.6	52.1	37.1	4.5	5.5	23.9	25.0	2160	39.6
		3							77.9	54.4	39.4	5.3	7.3			2175	
		4							80.1	56.6	41.6	6.0	9.0			2195	
		6							84.1	60.6	45.6	7.0	12.5			2240	
		8							88.4	64.9	49.9	8.3	16.0			2305	
		10							92.6	69.1	54.1	9.5	19.0			2415	
		12							97.1	73.6	58.6	11.0	22.5			2550	
	40	2		42.0	94.1	70.6	50.6	12.0	85.6	62.1	42.1	4.5	5.5	23.9	25.0	2285	47.6
		3							87.9	64.4	44.4	5.3	7.3			2300	
		4							90.1	66.6	46.6	6.0	9.0			2320	
		6							94.1	70.6	50.6	7.0	12.5			2360	
		8							98.4	74.9	54.9	8.3	16.0			2430	
		10							102.6	79.1	59.1	9.5	19.0			2535	
		12							107.1	83.6	63.6	11.0	22.5			2670	
48	205	20	2	48.0	77.1	52.1	42.1	12.0	68.6	44.1	34.1	4.5	5.5	26.9	28.0	2510	43.2
			3						70.9	46.4	36.4	5.3	7.3			2520	
			4						73.1	48.6	38.6	6.0	9.0			2540	
			6						77.1	52.6	42.6	7.0	12.5			2585	
			8						81.4	56.9	46.9	8.3	16.0			2650	
			10						85.6	61.1	51.1	9.5	19.0			2760	
			12						90.1	65.6	55.6	11.0	22.5			2895	
	30	2		48.0	87.1	62.1	47.1	12.0	78.6	54.1	39.1	4.5	5.5	26.9	28.0	2655	53.7
		3							80.9	56.4	41.4	5.3	7.3			2670	
		4							83.1	58.6	43.6	6.0	9.0			2685	
		6							87.1	62.6	47.6	7.0	12.5			2730	
		8							91.4	66.9	51.9	8.3	16.0			2800	
		10							95.6	71.1	56.1	9.5	19.0			2905	
		12							100.1	75.6	60.6	11.0	22.5			3040	
	40	2		48.0	97.1	72.1	52.1	12.0	88.6	64.1	44.1	4.5	5.5	26.9	28.0	2800	64.1
		3							90.9	66.4	46.4	5.3	7.3			2815	
		4							93.1	68.6	48.6	6.0	9.0			2830	
		6							97.1	72.6	52.6	7.0	12.5			2880	
		8							101.4	76.9	56.9	8.3	16.0			2945	
		10							105.6	81.1	61.1	9.5	19.0			3050	
		12							110.1	85.6	65.6	11.0	22.5			3180	



How To Order

Build an ordering code as shown in the example.
Each available only on the model sizes highlighted in the colored blocks preceding its description

Key To Blocks:

4

6

8

12

= Model 4

4

6

8

12

= Model 6

4

6

8

12

= Model 8

4

6

8

12

= Model 12 etc.

Example:

HOUSING

OPTION

245230- 4F-1-150-S-B-DOE-VP-C

MODEL NO.

= 4

= 6

= 8

= 12

= 16

= 18

= 22

= 24

= 30

= 36

= 42

= 48

NUMBER OF CARTRIDGES

[Around] Cartridges

= 1

= 3

= 6

= 12

= 20

= 27

= 40

= 52

= 82

= 116

= 158

= 205

CARTRIDGE LENGTH

10-in. = 10

20-in. = 20

30-in. = 30

40-in. = 40

PIPE SIZE NPT (female)

3/4-in. = 3/4P

1-in. = 1P

1-1/4-in. = 1-1/4P

1-1/2-in. = 1-1/2P

2-in. = 2P

3-in. = 3P

FLANGED

3/4 in. = 3/4F

1-in. = 1F

1-1/4-in. = 1-1/4F

1-1/2 in. = 1-1/2F

2-in. = 2F

3-in. = 3F

4-in. = 4F

6-in. = 6F

8-in. = 8F

10-in. = 10F

12-in. = 12F

ASME CODE STAMP

C = Code

CARTRIDGE SEALING METHOD

VP = V Post and Spring Seal

TP = Threaded Post

For other styles, consult factory

CARTRIDGE DESIGN

DOE = Double-Open End

SOE = Single Open End

222 = Double O-Ring

226 = Bayonet Lock (Pall)

COVER SEAL

B = Buna N

E = Ethylene Propylene

V = Viton

TEV = Teflon Encapsulated Viton

TSW = Teflon (solid white)

HOUSING MATERIAL

C = Carbon Steel

S = 304 Stainless Steel

S316 = 316 Stainless Steel

PRESSURE RATING

150 = 150 psi (NPT or flanged)

300 = 300 psi (NPT or flanged)

PIPING STYLE

1 = Side Inlet, Bottom Outlet

2 = In-line, Inlet-high, Outlet-low

1. Flanges provided with the housing match the pressure rating of the vessel. Housings rated 150 psi have 150 class flanges. Housings rated 300 psi have 300 class flanges. Other styles and classes are available. ANSI B16.5 Pressure-Temperature rating tables determine flange class for ASME code housings. Consult factory.

2. Consult factory for special options.

3. Higher pressure ratings available. Consult factory.

4. Filter cartridges are sold separately. See pages 134.

Pressure Drop Data

Cartridge filters are usually selected so that the clean pressure drop does not exceed 2 psi. Higher pressure drops may be tolerated when contaminant loading is low. The user must determine the appropriate cartridge for the application, and note the flow rate ΔP per cartridge as suggested by the media manufacturer.

Viscosity Factors

CPS NUMBER

1 50 100 200 400 600 800 1000 2000

(H₂O)

.65 .85 1.00 1.10 1.20 1.40 1.50 1.60 1.80

ENGINEERING STANDARDS

Rosedale Products, Inc.
3730 West Liberty Road
Ann Arbor, MI 48103

IOM
7_4_5 Model 8 150.wpd
n:\iom\



Issue Date: 07NOV95
Revision: E
Revision Date: 30May2003

Specification No.
7.4.5
PAGE: 1 of 6

INSTALLATION, OPERATION, & MAINTENANCE MANUAL

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

ROSEDALE PRODUCTS, INC.



MODEL 8

150 PSIG RATED FILTER UNIT

Table of Contents

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IOM
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Revision Date: 30May2003

Specification No.
7.4.5
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INSTALLATION, OPERATION, & MAINTENANCE MANUAL

I. Installation

Please remove all shipping and crating materials carefully. Be sure to remove the plugs from the inlet and outlet openings. Dispose of all crating materials safely.

The Model 8 Filter unit is capable of having several different piping variations based upon the outlet style of your unit. The inlet service line should be connected to the inlet flange or NPT coupling located near the top of the unit (above the basket level).

The outlet service line should be connected to the outlet flange or coupling, located near the middle or bottom of the unit depending upon the style of your unit (below basket level).

There are two 1/4" NPT ports on the shell and one 1/4" NPT port on the cover of the Model 8 Filter unit. These ports can remain plugged or used for pressure gauges or special fittings as your application requires.

Some installations require electrical grounding of all equipment, be sure to provide adequate grounding where necessary.

After completing installation be sure to double check connections for integrity. Your Model 8 Filter unit has been factory pressure tested leak free, therefore, any seepage problems usually occur from improper installation connections.

You are now ready to install the filter basket and bag. Remove cover by loosening the cover eyenuts. The eyenuts in the slotted corners should be loosened sufficiently to swing free. Loosen the third eyenut sufficiently to allow the top cover and closure assembly to swing away from the top of the unit.

If your application requires a basket seal, insert the basket seal into the basket collar groove. Refer to Figure 1 or Figure 2 in the Spare Parts Diagram for installation position of your seal.

Place the basket into the filter housing, make sure the basket flange is firmly seated into the basket collar.

Insert bag into the bag basket making sure filter bag ring is firmly seated inside the basket flange. For best results, be sure filter bag is installed fully extended to the bottom of the basket.

Before replacing cover assembly, inspect cover seal gasket (replacing as necessary). Close cover and alternately tighten the three clamp assemblies evenly to ensure a leak proof seal between the cover and housing body. Torque closure assemblies to a maximum of 60-90^{ft.-lbs}. Each installation may have different closure bolting torque requirements to effectively seal the filter vessel cover. Many installations require significantly lower closure bolting torque due to the variables explained below. The suggested torque values are for reference only. They are to be used as a guideline by maintenance personnel. These values are meant as a guideline for safe operation of the filter system at its maximum rated pressure. Many variables affect the torque required to operate the filter vessel without leaks. These variables include the diameter of the bolt, type and number of threads, material type and grade, condition of the nut bearing surface and lubrication of bolt threads and nut bearing surfaces. Other factors such as the condition of the o-ring, o-ring material, viscosity of the fluid being filtered, operating pressures, temperature, and the closure assembly tightening procedure must also be considered.

Your Rosedale Model 8 is now ready for operation!

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IOM
7_4_5 Model 8 150.wpd
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Specification No.
7.4.5
PAGE: 3 of 6

INSTALLATION, OPERATION, & MAINTENANCE MANUAL

II. Operation

Filter System Start-Up Procedure:

Prior to turning on the flow to the inlet service, please make the following checks:

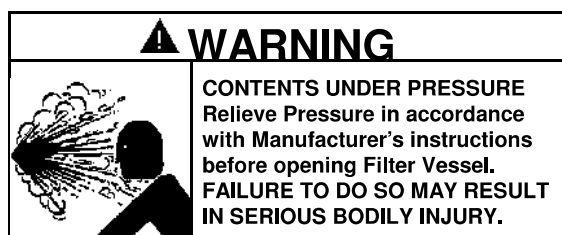
1. Check inside filter unit to be sure basket and filter bag (if applicable) are in housing and do not require cleaning or replacement. If necessary install a clean filter basket and bag (if applicable).
2. Check that filter unit cover is securely fastened to housing. You are now ready to open the flow to the inlet service line. Slowly open the inlet service line approximately 25% of normal operational flow (open slowly as not to displace filter bag inside the housing). After filter unit is pressurized and vented, slowly open outlet service line unit valve until completely open. Complete opening of inlet service line until desired flow rate is reached.

Once the desired service flow has been established, the filter will operate efficiently until dirty. However, under no circumstances should more than *15 PSI Differential Pressure* through the filter be obtained. Operating the filter unit with a high differential may cause filter bags to rupture and/or cause damage to filter system and downstream equipment.

To prevent excessive drop through the filter unit, regular inspection of the filter media is required. Monitoring of differential pressure through the housing can be utilized as a means of determining whether or not the filter media needs cleaning or replacement.

When it becomes necessary to clean or replace filter media, follow the procedure outlined below:

1. First close the flow from the inlet service line.
2. Close the flow to the outlet service line. (In some applications closing flow to outlet is not required.)
3. Relieve the pressure from the filter unit.



4. Drain housing sufficiently to access filter basket.
5. Remove cover by loosening the cover eyenuts. The eyenuts in the slotted corners should be loosened sufficiently to swing free. Loosen the third eyenut sufficiently to allow the top cover and closure assembly to swing away from the top of the unit.
6. Remove filter basket and clean thoroughly, remove the filter bag (if applicable) and throw away. (Cleaning and reusing the filter bag is not recommended.)
7. Remove debris and sludge from inside the inlet portion of housing to avoid interference with cover seal or flow of fluid being filtered.
8. Remove basket seal and inspect, replace if necessary. Clean basket seal groove and replace

Rosedale Engineering Standards are the property of Rosedale Products, Inc. A Rosedale standard or copy thereof shall not be distributed (except with express approval of Rosedale Products, Inc.) to any individual or firm beyond the intended recipient firm or individual. Firms of individuals acting contrary to the above may be subject to suit, ineligibility for continued or future employment, or removal from Rosedale's "Approved Manufacturers and Specialty Contractors List".

ENGINEERING STANDARDS

Rosedale Products, Inc.
3730 West Liberty Road
Ann Arbor, MI 48103

IOM
7_4_5 Model 8 150.wpd
n:\iom\



Issue Date: 07NOV95
Revision: E
Revision Date: 30May2003

Specification No.
7.4.5
PAGE: 4 of 6

INSTALLATION, OPERATION, & MAINTENANCE MANUAL

- basket seal (see spare parts diagram for location of basket seal).
9. Install clean filter basket and filter bag (if applicable). Place the basket into the filter housing, make sure the basket flange is firmly seated into the basket collar. If applicable, insert bag into the bag basket making sure filter bag ring is firmly seated inside the basket flange. For best results, be sure filter bag is installed fully extended to the bottom of the basket.
 10. Inspect cover gasket for cuts or other signs of failure and make sure it is properly seated.
 11. Move cover back into position, and alternately tighten the three clamp assemblies evenly to ensure a leak proof seal between cover and housing body. Torque closure assemblies to a maximum of 60-90^{ft-lbs}. Many installations require significantly lower closure bolting torque due to the variables previously explained in Section I.

Your Rosedale Model 8 Filter unit is now ready for operation. Refer to filter system start-up procedure.

III. Spare Parts List

Your Rosedale Model 8 Filter unit will give you many years of reliable service provided periodic inspections are made of various components and replacement of worn parts are made promptly. The following is meant to be a recommended spare parts list, these parts are illustrated on the following page.

SPARE PARTS LIST			
Balloon	Description	Part Number	Time-Frame
1	Cover Seal	8150CG-*	as needed
2	Basket Seal	8BG-*	as needed
3	Cover	8*150	as needed
4	Eye Nut	8ENNI	as needed
5	Rod End	8RENI	as needed
6	Clevis Pin Assembly	8CPNI	as needed
7	Filter Bag	(See Order)	as needed
8	Filter Basket	(See Order)	as needed
9	Tripod Legs	8T22*S	as needed

* Select Material Designation:

C=Carbon Steel
S=304 Stainless Steel
S316=316 Stainless Steel

B=Buna N
E=Ethylene Propylene
V=Viton
TEV=Teflon Encapsulated Viton
TSW=Teflon Solid White

[Buy Parts Online](#)

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ENGINEERING STANDARDS

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Issue Date: 07NOV95
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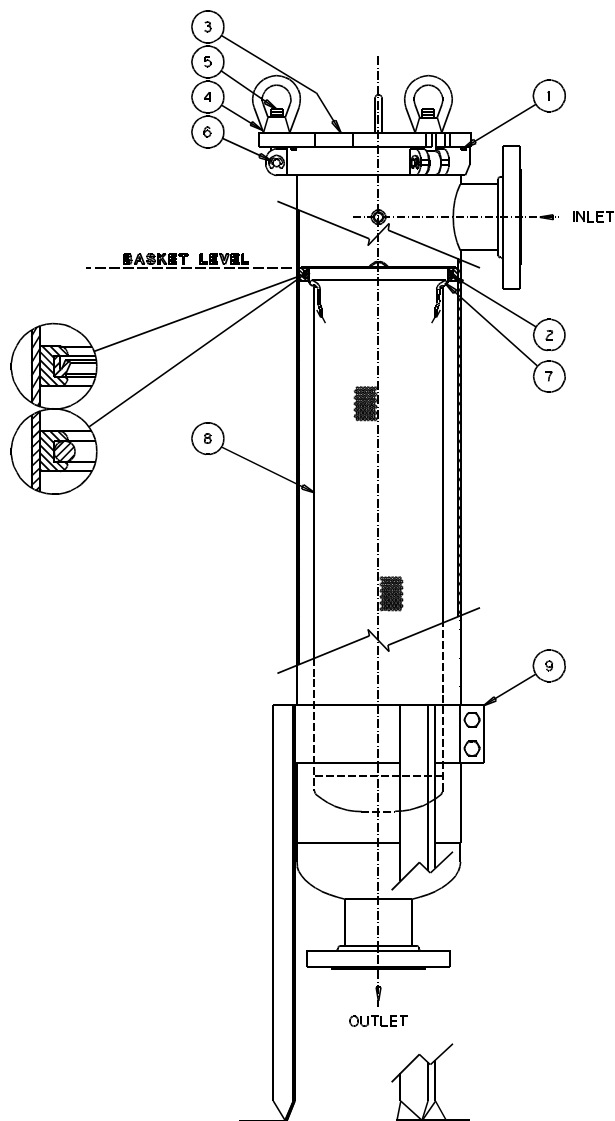
Specification No.
7.4.5
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INSTALLATION, OPERATION, & MAINTENANCE MANUAL

IV. Spare Parts Diagram

Figure 1
V-seal

Figure 2
O-ring



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Issue Date: 07NOV95
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Specification No.
7.4.5
PAGE: 6 of 6

INSTALLATION, OPERATION, & MAINTENANCE MANUAL

Important Notice

Warranty: In the event any Rosedale Products, Inc. filtration product is found to be defective in material, workmanship, or not in conformance with any express warranty for a specific purpose, Rosedale's only obligation and your exclusive remedy, shall be to repair, replace or refund the purchase price of such parts or products upon timely notification thereof and substantiation that the product has been stored, maintained and used in accordance with Rosedale's written instructions.

EXCLUSIONS TO WARRANTY: THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT.

LIMITATION OF LIABILITY: Except as provided above, Rosedale shall not be liable or responsible for any loss or damage, whether direct, indirect, incidental, special or consequential, arising out of sale, use or misuse of Rosedale filtration products, or the user's inability to use such products.

THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE.

Rosedale Products, Inc.
3730 West Liberty Road
Ann Arbor, MI 48103 USA
734-665-8201
800-821-5373
Fax. 734-665-2214
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Wound Filter Cartridges

Wound Filter Cartridge Chemical Compatibility Guide

String/Core Material	Max. Temp.	Mineral Acids	Organic Acids	Alkalies	Oxidizing Agents	Organic Solvents	Petroleum Oils	Water
Polypropylene/ Polypropylene	140°F	Good	Excellent	Excellent	Fair	Excellent	Excellent	Excellent
Cotton/Tin Steel	250°F	Poor	Good	Good	Fair	Good	Excellent	Excellent
Cotton/Polypropylene	140°F	Poor	Good	Good	Fair	Good	Good	Excellent
Cotton/316 SS	250°F	Poor	Good	Good	Fair	Good	Excellent	Excellent
Rayon/Tin Steel	250°F	Poor	Fair	Good	Fair	Good	Good	Excellent
Glass Fiber/304 SS	750°F	Excellent	Excellent	Poor	Excellent	Excellent	Excellent	Poor

String-Wound Filter Cartridges

Grainger Item# 3P792



- 2 1/16" O.D., 1" I.D.
- Pkg. of 6

Single-piece construction eliminates spacers and bypassing. Fulflo® Honeycomb depth cartridges trap the solid particles on and within the depth of the entire cartridge. Fit all similar competitive housings. Typically used in petrochemical, plating, printing, printed circuit, well service, pharmaceutical, photographic, oil, gas, process water, and laboratory applications.

No. 1LPA8									
Microns	Flow Rate (gpm)	10" L Item No.	\$ Pkg.	Flow Rate (gpm)	20" L Item No.	\$ Pkg.	Flow Rate (gpm)	30" L Item No.	\$ Pkg.
FDA Cotton/Polypropylene Core, Max. Temp.: 120°F									
1	3	3P811	41.45	6	5P254	82.80	9	5P259	123.55
5	4	3P812	39.40	8	5P255	78.75	12	5P260	117.15
10	5	3P813	38.35	10	5P256	76.70	15	5P261	114.50
20	6	3P814	36.60	12	5P257	73.30	18	5P262	109.45
50	6	3P815	34.15	12	5P258	68.30	18	5P263	101.75
75	6	1LPA8	32.00	12	1LPA6	63.90	18	1LPA4	95.25
100	6	1LPA9	30.00	12	1LPA7	60.00	18	1LPA5	89.85
FDA Cotton/Tin Steel Core, Max. Temp.: 200°F									
1	3	3P795	40.35	6	5P283	81.10	9	3P799	120.10
5	4	5P282	37.80	8	5P284	75.60	12	3P800	112.35
10	5	3P796	36.70	10	5P285	73.60	15	5P288	109.45
25	6	3P797	35.00	12	5P286	70.15	18	3P801	104.20
50	6	3P798	32.15	12	5P287	64.75	18	5P269	95.90
75	6	1LPA2	30.70	12	1LNZ9	61.25	18	1LNZ1	91.25
100	6	1LPA3	28.60	12	1LPA1	57.20	18	1LNZ8	85.85
FDA Cotton/316 Stainless Steel Core, Max. Temp.: 250°F									
1	3	3P802	52.90	6	1LPH4	87.20	9	3P807	157.00
5	4	3P803	51.70	8	5P271	102.25	12	3P808	153.25
10	5	3P804	48.80	10	5P290	96.35	15	3P809	150.75
25	6	3P805	48.35	12	5P291	95.75	18	3P810	143.60
50	6	3P806	45.75	12	5P270	90.80	18	5P292	135.95
75	6	1LPH5	43.60	12	1LPH3	87.05	18	1LPH1	126.70
100	6	1LPH6	41.65	12	1LPH4	80.55	18	1LPH2	123.80
FDA Polypropylene/Polypropylene Core, Max. Temp.: 120°F									
1	3	1LPP1	32.00	6	1LPP8	63.90	9	1LPG6	95.10
5	4	1LPP2	29.85	8	1LPP9	59.70	12	1LPG7	88.85
10	5	1LPP3	29.50	10	1LPG1	58.85	15	1LPG8	88.25
20	6	1LPP4	27.60	12	1LPG2	55.00	18	1LPG9	82.30
50	6	1LPP5	25.90	12	1LPG3	52.10	18	1LPH1	77.40
75	6	1LPP6	25.40	12	1LPG4	50.80	18	1LPH2	76.05
100	6	1LPP7	25.05	12	1LPG5	50.20	18	1LPH3	75.20

Microns	Flow Rate (gpm)	10" L Item No.	\$ Pkg.	Flow Rate (gpm)	20" L Item No.	\$ Pkg.	Flow Rate (gpm)	30" L Item No.	\$ Pkg.
Non-FDA Polypropylene/Polypropylene Core, Max. Temp.: 120°F									
1	3	3P786	32.75	6	5P264	65.50	9	3P790	97.45
5	4	3P787	31.70	8	5P265	63.80	12	3P791	94.90
10	5	3P788	30.90	10	5P266	61.95	15	3P792	92.25
25	6	3P789	29.70	12	5P267	59.85	18	3P793	88.90
50	6	5P297	28.90	12	5P268	57.35	18	3P794	85.75
75	6	1LNZ5	26.50	12	1LNZ3	52.10	18	1LNZ1	77.10
100	6	1LNZ6	24.80	12	1LNZ4	49.85	18	1LNZ2	74.55
Rayon/Tin Steel Core, Max. Temp.: 200°F									
1	3	1LPD3	38.35	6	1LPC5	69.45	9	1LPB7	97.80
5	4	1LPD4	36.10	8	1LPC6	68.00	12	1LPB8	92.40
10	5	1LPD5	34.75	10	1LPC7	63.45	15	1LPB9	89.45
25	6	1LPD6	31.40	12	1LPC8	59.55	18	1LPC1	85.65
50	6	1LPD7	30.50	12	1LPC9	57.10	18	1LPC2	79.00
75	6	1LPD8	30.35	12	1LPD1	53.75	18	1LPC3	78.20
100	6	1LPD9	30.00	12	1LPD2	54.95	18	1LPC4	73.10
Glass Fiber/Type 304 Stainless Steel Core, Max. Temp.: 750°F									
0.5	5	4NUX4	83.30	10	4NUY3	151.25	—	—	—
1	5	4NUX5	79.35	10	4NUY4	149.50	—	—	—
5	5	4NUX6	79.35	10	4NUY5	149.50	—	—	—
10	5	4NUX7	74.15	10	4NUY6	140.30	—	—	—
20	5	4NUX8	74.15	10	4NUY7	140.30	—	—	—
40	5	4NUX9	74.15	10	4NUY8	140.30	—	—	—
100	5	4NUY1	66.80	10	4NUY9	124.30	—	—	—
150	5	4NUY2	66.80	10	4NUZ1	124.30	—	—	—

Large-Diameter String-Wound Filter Cartridges

- 4 1/2" O.D., 1" I.D.
- Pkg. of 6



No. 4NVL1

Microns	L (in.)	Flow Rate (gpm)	Item No.	\$ Pkg.
Polypropylene/Polypropylene Core, Max. Temp.: 120°F				
1	9 1/2	8	4NVL1	106.55
5	9 1/2	8	4NVL2	99.00
10	9 1/2	8	4NVL3	97.15
20	9 1/2	8	4NVL4	95.50
50	9 1/2	8	4NVL5	93.05
100	9 1/2	8	4NVL6	90.35
1	20	16	4NVL7	192.00
5	20	16	4NVL8	187.25
10	20	16	4NVL9	184.75
20	20	16	4NVN1	178.00
50	20	16	4NVN2	173.25
100	20	16	4NVN3	161.75

All are compatible with a variety of organic solvents.

Microns	L (in.)	Flow Rate (gpm)	Item No.	\$ Pkg.
FDA Cotton/304 Stainless Steel Core, Max. Temp.: 250°F				
1	9 1/2	8	4NVN4	148.25
5	9 1/2	8	4NVN5	139.70
10	9 1/2	8	4NVN6	139.70
20	9 1/2	8	4NVN7	134.65
50	9 1/2	8	4NVN8	129.35
100	9 1/2	8	4NVN9	122.45
1	20	16	4NVP1	258.75
5	20	16	4NVP2	255.75
10	20	16	4NVP3	255.75
20	20	16	4NVP4	246.00
50	20	16	4NVP5	238.25
100	20	16	4NVP6	223.75

Blanket-Wound Filter Cartridges

- 2 1/2" O.D., 1" I.D.



Suitable for food and beverage and other regulated applications. Allows for very low pressure drops, high flow rates, longer filter life, and more cost-effective filtration. Ideal for potable water, food processing, electronics, and electroplating applications. Components are CFR 21 compliant.

No. 2PWX6									
10" L			20" L			30" L			
Microns	Flow Rate (gpm)	Item No.	Flow Rate (gpm)	Item No.	Flow Rate (gpm)	Flow Rate (gpm)	Item No.	Item No.	\$ Each
Cotton/Stainless Steel Core, Max. Temp.: 250°F									
0.5	5	2PWX6	24.52	10	2UDJ2	50.10	15	2UDL4	72.30
1	5	2PWX7	22.63	10	2UDJ3	45.75	15	2UDL5	68.10
3	5	2UDG2	21.77	10	2UDJ4	43.15	15	2UDL6	65.85
5	5	2UDG3	20.63	10	2UDJ5	42.35	15	2UDL7	62.75
10	5	2UDG4	19.20	10	2UDJ6	39.65	15	2UDL8	57.05
25	5	2UDG5	18.74	10	2UDJ7	38.10	15	2UDL9	54.85
50	5	2UDG6	18.29	10	2UDJ8	35.60	15	2UDN1	54.70
75	5	2UDG7	18.05	10	2UDJ9	35.90	15	2UDN2	51.50
100	5	2UDG8	18.05	10	2UDK1	36.95	15	2UDN3	51.50
350	5	2UDG9	18.05	10	2UDK2	36.95	15	2UDN4	51.50

Polypropylene/Polypropylene Core, Max. Temp.: 150°F									
10" L			20" L			30" L			
Microns	Flow Rate (gpm)	Item No.	Flow Rate (gpm)	Item No.	Flow Rate (gpm)	Flow Rate (gpm)	Item No.	Item No.	\$ Each
0.5	5	2UDH1	21.04	10	2UDK3	44.40	15	2UDN5	64.35
1	5	2UDH2	19.20	10	2UDK4	40.05	15	2UDN6	58.20
3	5	2UDH3	18.29	10	2UDK5	38.55	15	2UDN7	56.00
5	5	2UDH4	17.14	10	2UDK6	36.60	15	2UDN8	52.90
10	5	2UDH5	15.76	10	2UDK7	32.95	15	2UDN9	49.30
25	5	2UDH6	15.19	10	2UDK8	32.40	15	2UDP1	46.90
50	5	2UDH7	14.79	10	2UDK9	30.90	15	2UDP2	45.15
75	5	2UDH8	14.45	10	2UDL1	31.20	15	2UDP3	43.55
100	5	2UDH9	14.45	10	2UDL2	30.35	15	2UDP4	43.55
350	5	2UDJ1	14.45	10	2UDL3	30.35	15	2UDP5	44.80

3978 GRAINGER

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✓ = Repair & Replacement Coverage Available

Aqua-Scrub® Low Pressure Liquid Phase Adsorbers

The Aqua-Scrub® adsorbers are designed to provide uniform water flow for consistent treatment and to ensure efficient carbon usage. These adsorbers can be cost effectively used in applications including:

- Groundwater remediation
- Wastewater filtration
- Pilot testing
- Leachate treatment
- Dechlorination
- Spill cleanup

Installation, Start Up and Operation

The Aqua-Scrub® adsorbers are shipped filled with dry activated carbon that must be properly wetted and deaerated prior to use.

Your Siemens sales representative can assist with details on installation, preferred operating conditions and carbon usage calculations using our extensive isotherm database.

At the time of purchase or rental of the Aqua-Scrub® adsorbers, arrangements should be made for the reactivation of the spent carbon. Siemens will provide

instructions and assistance to obtain acceptance of RCRA or non-RCRA spent carbon for reactivation.

Aqua-Scrub® adsorbers must be drained and the inlet/outlet plugged prior to shipment. Spent carbon cannot be received until the acceptance process has been completed.

Benefits and Design Features

- Rugged carbon steel construction; internally/externally welded seams
- SSPC-SP5 surface preparation, fusion bonded epoxy internal lining; rust preventative/urethane exterior coat (Aqua-Scrub® 1000/2000 Adsorbers)
- Approved for the transport of hazardous spent carbon
- Aqua-Scrub® 1000/2000 can be easily moved with a forklift
- Adapters are available to reduce the inlet/outlet to 1" FNPT (Aqua-Scrub® 2000 Adsorbers) and 2" FNPT (Aqua-Scrub® 1000/2000 Adsorbers)
- Cartridge and bag prefilters available
- Aqua-Scrub® 1000/2000 Adsorbers are available for rental or purchase

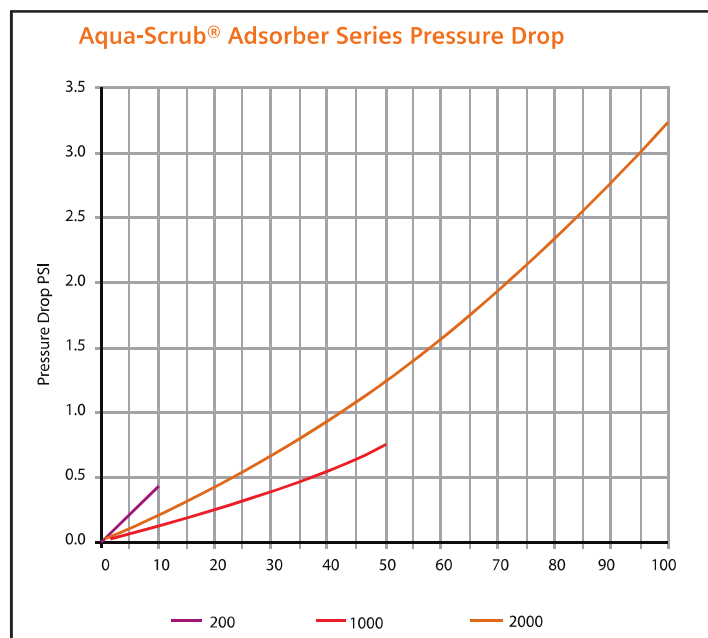
Piping Manifold (Optional)

- 2"/3" sch 80 PVC piping and valves (optional carbon steel and stainless steel piping)
- Series or parallel operation
- Clean utility water connection for manual backflush
- Sampling ports and pressure gauges
- Flexible hoses with Kamlock fittings allow easy installation and removal during service exchange operations



SPECIFICATIONS			
Aqua-Scrub® Adsorber Model No.	200	1000	2000
Dimensions, diameter x overall height	22" x 34"	48" x 57"	48" x 95"
Vessel Construction	Carbon Steel	Carbon Steel	Carbon Steel
Inlet/Outlet Connection	2" FNPT/2"MNPT	4" FNPT	4" FNPT
Manway	Top	18"	18"
Internal Piping	PVC	PVC	PVC
Interior Coating	Epoxy	Epoxy	Epoxy
Exterior Coating	Enamel	Polyester	Polyester
Carbon Bed Volume (cu.ft.)	6.8	34	68
Cross Section (sq.ft.)	2.6	12.3	12.3
Vessel Weight (lbs) Shipping (carbon) Operating (approx)	250 500	1890 4280	3190 7250
Flow, GPM (max.)	10	50	100
Pressure, psig (max.)	6	25	25
Temperature, °F (max)	140°	140°	140°
Pounds of Carbon	200	1000	2000
Backflush rates (GPM)	5-10	40-50	40-50

For detailed specifications or dimensional information or drawings, contact your local Siemens Water Technologies sales representative.



Wet activated carbon readily adsorbs atmospheric oxygen. Dangerously low oxygen levels may exist in closed vessels or poorly ventilated storage areas. Workers should follow all applicable state and federal safety guidelines for entering oxygen depleted areas.

All information presented herein is believed reliable and in accordance with accepted engineering practices. Siemens makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. Siemens assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products.

Siemens
Water Technologies
866.613.5620 phone

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The information provided in this literature contains merely general descriptions or characteristics of performance which in actual case of use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of the contract.

www.siemens.com/es

VCC 8x30 Virgin Coconut Shell Carbon

BakerCorp's VCC 8x30 mesh virgin carbon made from select grades of coconut shell. These activated carbon granules are a uniform adsorbent with well developed pore structure, allowing for a wide range of adsorbate retention. This carbon is ideal for purification of potable water, industrial wastewater treatment and groundwater treatment. This product is also suitable for refinement of organic liquids requiring purification and color reduction, such as amine and glycol solutions and will remove MTBE from groundwater.

PHYSICAL PROPERTIES:

Carbon Tetrachloride Activity:	60% minimum
Apparent Density (lbs./cu.ft.):	29 average
Total Ash Content:	3% maximum
Hardness (Ball Abrasion):	98% minimum
Iodine Number:	1,000 minimum
Moisture (as packed):	5% maximum
Mesh Size:	8x30

Standard Packaging: 1000 lb. super sacks. Other packaging available upon request.

These specifications represent general parameters and are subject to change. Please consult with BakerCorp before processing with your applications.

4306 W. 190th Street, Torrance, California 90504
Phone: 310.303.3700 ♦ Fax: 310.406.3001

MATERIAL SAFETY DATA SHEET

DATE OF ISSUE: February 16, 2011

SECTION I- GENERAL INFORMATION**MANUFACTURER NAME: BakerCorp 562.904.3680****5500 Rawlings Ave, Southgate, CA 90280****CHEMICAL NAMES & SYNONYMS:** Activated Carbon, Activated Coconut, Activated Charcoal, Char**TRADE NAMES & SYNONYMS: Activated Carbon****CHEMICAL FAMILY:** Amorphous Carbon, Activated Coconut **FORMULA:** Carbon atom in a crystallite structure has an infinite molecular weight, Anthracite Coal, Sub-Bituminous Coal, Bituminous Coal **CAS NO.** 7440-440**SECTION II- HAZARDOUS INGREDIENTS****CHEMICAL NAME (Ingredients) [% TLV (Units)]:** No Hazardous Ingredients**HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASSES [% TLV (Units)]: LIQUIDS**

Activated Carbons that have adsorbed other carbon or non-carbon liquids or gasses may lower or raise the ignition point and must be laboratory checked for ignition point when expended.

SECTION III- PHYSICAL DATA**BOILING POINT (DEG F):** 4200**SPECIFIC GRAVITY (H2O-1):** 1.8-2.1**VAPOR PRESSURE (MM HG) N/A****PERCENT VOLATILE BY VOLUME:** none**VAPOR DENSITY (AIR=1):** N/A**EVAPORATION RATE:** none**SOLUBILITY IN WATER:** insoluble**IGNITION TEMPERATURE:** 600 deg C**APPEARANCE & ODOR:** Odorless, black granular solid**SECTION IV- FIRE HAZARD & EXPLOSIVE DATA****FLASH POINT (method used):** none**FLAMMABLE LIMITS:** Lower Explosive Limit: N/A Upper Explosive Limit: N/A**EXTINGUISHED MEDIA:** Use media for class A fires: Foam, multipurpose dry chemical and water type extinguishers.**SPECIAL FIRE FIGHTING PROCEDURES:** none**UNUSUAL FIRE & EXPLOSION HAZARDS:** Provide for the handling of dry flowing solids in grounded equipment to prevent build up of static electric charge especially when explosive dust or vapor mixtures may exist in confined areas. Also provide for pressure relief devices following the principles set forth in the National Fire Protection Association Explosion Preventing Guide NFPS68-1854.

SECTION V- HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: Avoid exposure to dust levels 15 mg per cubic meter.

(Federal), 10 mg per cubic meter (California State).

EFFECTS OF OVEREXPOSURE: Temporary dryness to mucous membrane causing coughing and minor nose and throat irritation.

EMERGENCY AND FIRST AID PROCEDURES: Wash mouth with water-no other treatment required.

Use protective respiratory equipment to avoid inhaling carbon dust.

SECTION VI- REACTIVITY DATA

STABILITY: UNSTABLE→ STABLE→ **X**

CONDITIONS TO AVOID: Activated Carbon is chemically inert

INCOMPATIBILITY (Materials to avoid): none

HAZARDOUS DECOMPOSITION PRODUCTS: none

HAZARDOUS POLYMERIZATION: MAY OCCUR→ WILL NOT OCCUR→**X**

SECTION VII- SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Spills can create nuisance dust and house keeping problems. Vacuuming is best clean up procedure.

WASTE DISPOSAL METHOD: Wet or dry activated carbon is best disposed of by landfill.

SECTION VIII-PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify Type): Respiratory classifications table G-2 part 1910.93 (OESHA) Rules & Regulations.

VENTILATION: LOCAL EXHAUST: Vacuum to control dust

PROTECTIVE GLOVES: None required

EYE PROTECTION: For airborne dust

OTHER PROTECTIVE EQUIPMENT: Protective clothing should be worn during handling to protect against airborne dust.

SECTION IX- SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Packaged activated carbon is not resistant to weather or outside storage and requires indoor Type I and Type II storage facilities.

OTHER PRECAUTIONS: Check oxygen content of atmosphere of any vessel containing activated carbon before allowing entry of personnel.

SECTION X- TRANSPORTATION DATA

PROPER SHIPPING (Article) NAME: Steam Activated Carbon, Non-Regulated **OR** Carbon, Activated, Non-Regulated

DOT CLASSIFICATION: NMFC 40560 / DOT MARKING: N/A / DOT PLACARD: N/A

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES:

Contact: BakerCorp

Phone: 562.904.3680

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: N/A

The information contained herein is based on data considered accurate in light of current formulation.

However, no warranty is expressed or implied regarding the accuracy of this data or the results to be obtained from the use thereof.

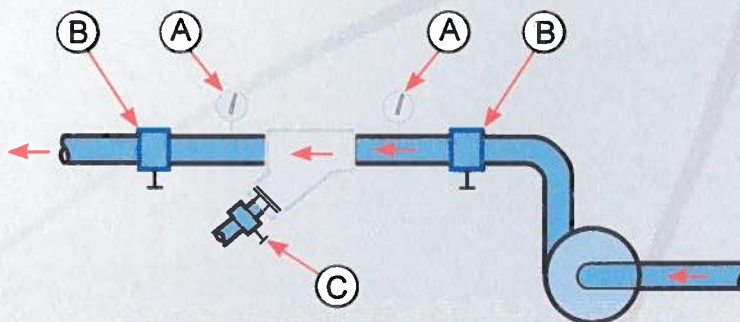
5500 Rawlings Ave, Southgate, California 90280

Phone: 562.904.3680 ♦ Fax: 562.904.1583

Y STRAINERS

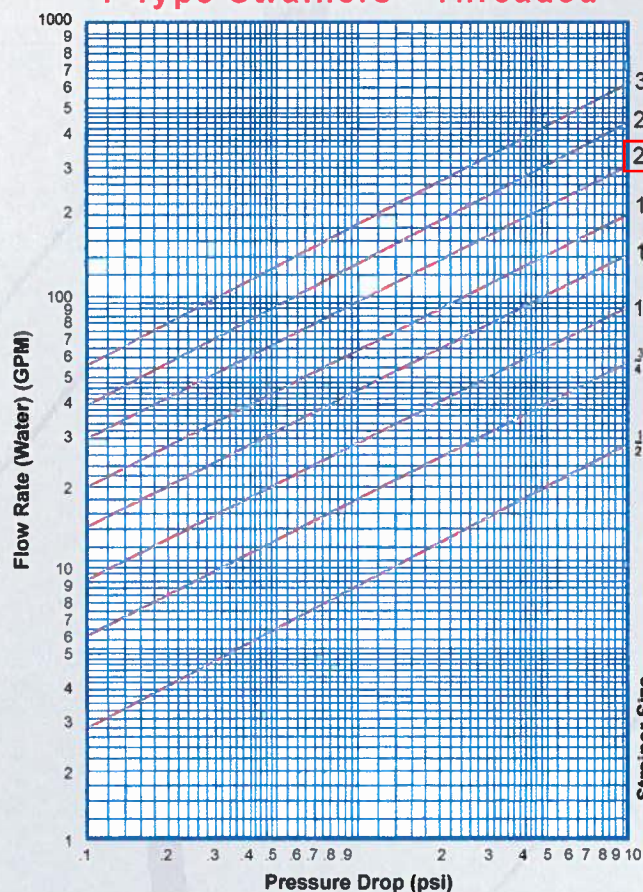
"Y" Strainers take their name from their configuration. They are most commonly used in pressurized lines, gas or liquid, but can also be used in suction or vacuum conditions. They are intended for applications where small amounts of solid particulate are expected, and where clean-out will be infrequent. If solids will flush easily from the screen, and fluid can be exhausted to atmosphere, a blow-down valve on the drain port will allow clean-out without removal of the screen, and without interrupting the process flow.

- A. Pressure gauges to indicate clogged screen
- B. Isolation valves for servicing strainer
- C. Optional manual or auto blow-down

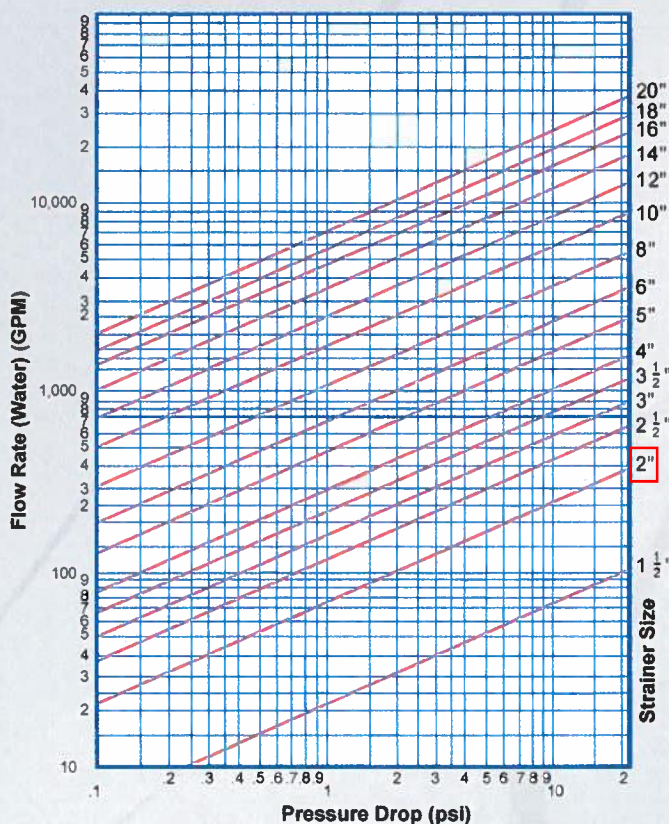


Flow Rate Vs. Pressure Drop (Clean Screen)

Y Type Strainers - Threaded



Y Type Strainers - Flanged



Note: These charts are for theoretical calculations ONLY.

Please contact our office with your exact specifications and you will be provided with factory calculations.



Sure Flow
Equipment Inc.

Toll Free: 1-800-263-8251 Toll Free Fax: 1-800-876-1164
International: 1-905-335-1350 International Fax: 1-905-332-4993
Email: info@sureflowequipment.com www.sureflowequipment.com



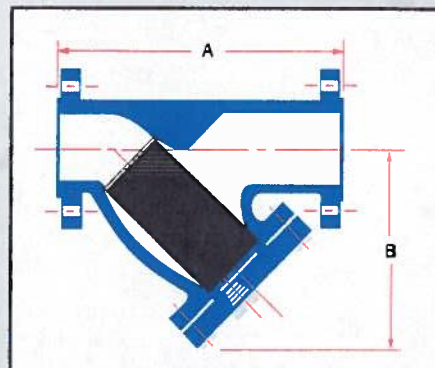
CAST Y STRAINERS

YF150 / YF150SS - Cast Steel / Cast 316 Stainless Steel

Class 150 Flanged End Connections



Sure Flow Class 150 ASME Flanged strainers are available in Carbon Steel and Stainless Steel. A machined, tapered seat ensures a perfect fit for the removable, stainless steel screen. Size 2" and larger come complete with flanged blow-off cover, gasket & plug. 1 1/2" and smaller come complete with solid threaded cover and gasket. May be installed in vertical or horizontal pipelines with blow-off connection at the lower end of the screen.



Notes:

- Must specify if for steam service
- Sizes 14" and larger are available in Cast Steel only.

Manufacturer reserves the right to modify dimensions, materials, or design. Consult factory for certification.

Construction

Carbon Steel - Body, Cover - ASTM A216 Grade WCB

Stainless Steel - Body, Cover - ASTM A351 Grade CF8M

All screens are Stainless Steel

Size		Dimensions (Inches)		Blow-Off NPT	Shipping Weight (LBS)
Inches	Prefix	A	B		
1/2	0050	6	2 9/16	1/4	9
3/4	0075	7 1/2	3	1/4	11
1	0100	7 3/8	3 3/8	1/4	15
1 1/2	0150	7 1/4	4 3/4	1/2	18
2	0200	8 5/8	4 7/8	1/2	30
2 1/2	0250	10 1/4	7 1/2	3/4	44
3	0300	11 5/8	7 3/4	1	60
4	0400	14 1/4	9 1/8	1 1/2	96
5	0500	17 5/8	11	2	150
6	0600	18 5/8	13 3/8	2	174
8	0800	24 3/8	14 5/8	2	264
10	1000	26	17 1/4	2	414
12	1200	30 3/8	21	2	615
14	1400	36	27 3/16	2	720
16	1600	46 9/16	30 1/4	2	956
18	1800	46	35 11/16	2	1130
20	2000	49 1/2	40	2	1500
24	2400	58 3/8	44 1/2	2	1990

Ordering Information

Example: Include full description

Size Model Screen
(Prefix) Number Opening

0400 YF150SS 125

4" Flanged, Y Strainer, Cast Stainless Steel, Class 150
ASME Flanges, 1/8" Perf Screen

Operating Pressures and Temperatures

Type	Size	psi @ Temp Steam*	psi @ Temp WOG
YF150	1/2" - 24"	150 @ 358 °F	285 @ 100 °F
YF150SS	1/2" - 12"	150 @ 358 °F	275 @ 100 °F

Standard Screens

Size	Standard	Opening
1/2" - 1 1/2"	1/32" perf	0.032"
2" - 3"	3/64" perf	0.045"
4" - 24"	1/8" perf	0.125"



Sure flow
Equipment Inc.

Toll Free: 1-800-263-8251 Toll Free Fax: 1-800-876-1164
International: 1-905-335-1350 International Fax: 1-905-332-4993
Email: info@sureflowequipment.com www.sureflowequipment.com





T-10 METER

SIZES: 1 1/2" and 2"



T-10 water meters are warranted for performance, materials, and workmanship.



Every T-10 water meter meets or exceeds the latest AWWA C700 Standard. Its nutating disc, positive displacement principle has been time-proven for accuracy and dependability since 1892, ensuring maximum utility revenue.

CONSTRUCTION

The T-10 water meter consists of three major assemblies: a register, a lead free high copper alloy maincase, and a nutating disc measuring chamber.

The T-10 meter is available with a variety of register types. For reading convenience, the register can be mounted in one of four positions on the meter.

The corrosion-resistant lead free high copper alloy maincase will withstand most service conditions: internal water pressure, rough handling, and in-line piping stress.

The innovative floating chamber design of the nutating disc measuring element protects the chamber from frost damage while the unique chamber seal extends the low flow accuracy by sealing the chamber outlet port to the maincase outlet port. The nutating disc measuring element utilizes corrosion-resistant materials throughout and a thrust roller to minimize wear.

WARRANTY

Neptune provides a limited warranty with respect to its T-10 water meters for performance, materials, and workmanship.

When desired, maintenance is easily accomplished either by replacement of major assemblies or individual components.

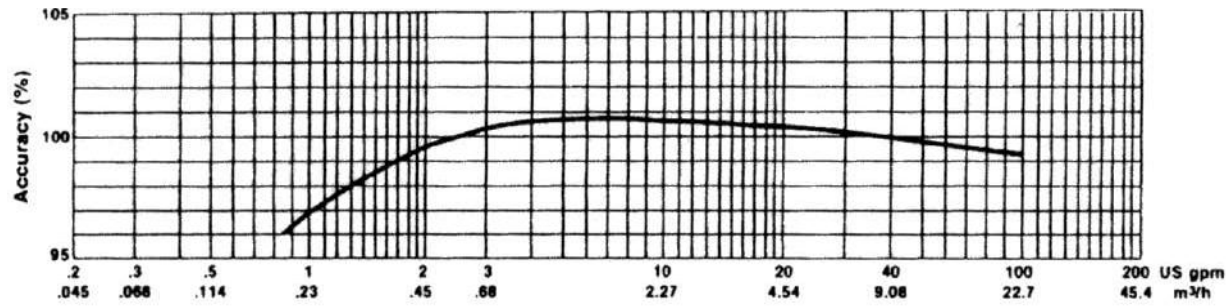
KEY FEATURES

- Register
 - Magnetic drive, low torque registration ensures accuracy
 - Impact-resistant register
 - High resolution, low flow leak detection
 - Bayonet style register mount allows in-line serviceability
 - Tamperproof seal pin deters theft
 - Date of manufacture, size, and model stamped on dial face
- Lead Free Maincase
 - Made from lead free high copper alloy
 - NSF/ANSI 61 Certified, Annex G and Annex F compliant
 - Lifetime guarantee
 - Resists internal pressure stresses and external damage
 - Handles in-line piping variations and stresses
 - Lead free high copper alloy provides residual value vs. plastic
 - Electrical grounding continuity
- Nutating Disc Measuring Chamber
 - Positive displacement
 - Widest effective flow range for maximum revenue
 - Proprietary polymer materials maximize long term accuracy
 - Floating chamber design is unaffected by meter position or in-line piping stresses

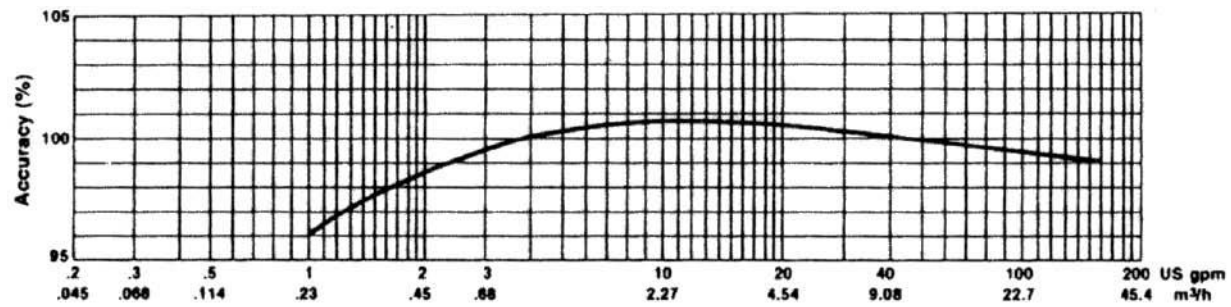
SYSTEMS COMPATIBILITY

Adaptability to all present and future systems for flexibility is available only with Neptune's ARB® Utility Management Systems™.

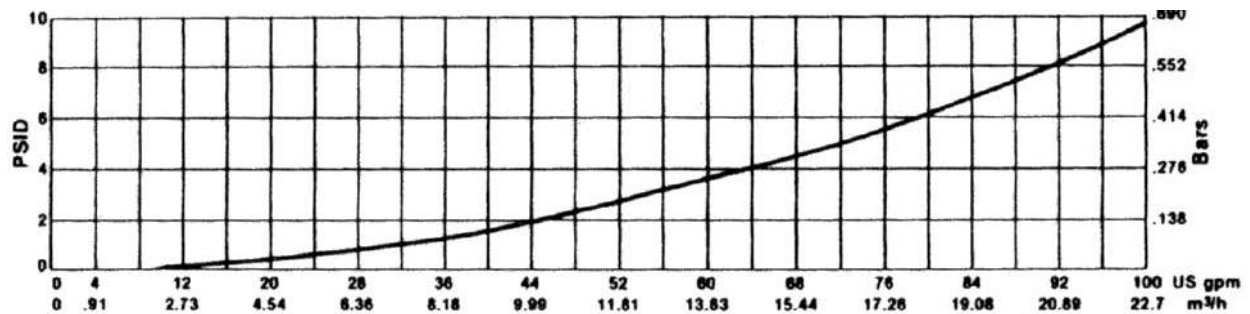
1 1/2" ACCURACY



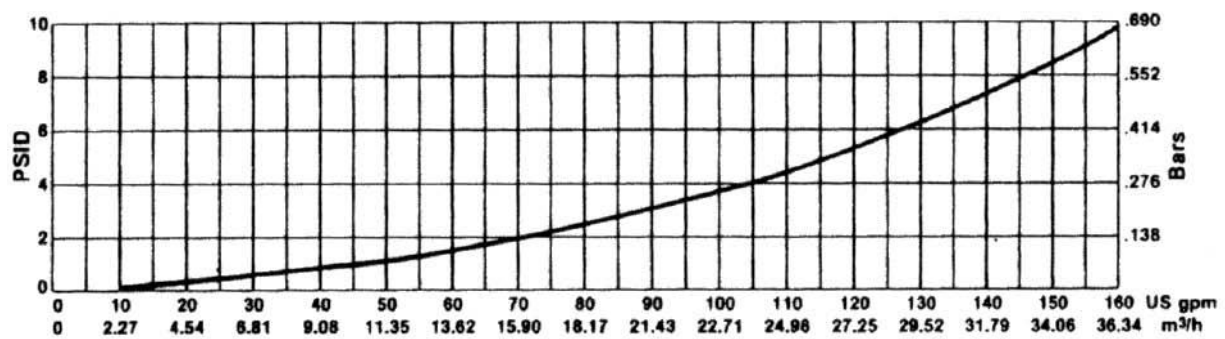
2" ACCURACY



1 1/2" PRESSURE LOSS



2" PRESSURE LOSS



These charts show typical meter performance. Individual results may vary.

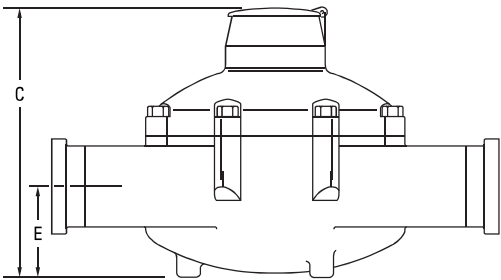
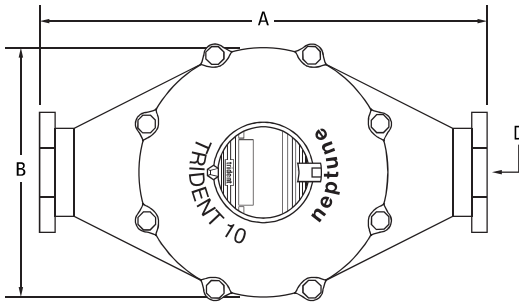
OPERATING CHARACTERISTICS

Meter Size	Normal Operating Range @100% Accuracy (±1.5%)	AWWA Standard	Low Flow @ 95% Accuracy
1 1/2"	2 to 100 US gpm 0.46 to 22.73 m³/h	5 to 100 US gpm 1.1 to 22.7 m³/h	3/4 US gpm 0.17 m³/h
2"	2 1/2 to 160 US gpm 0.57 to 36.36 m³/h	8 to 160 US gpm 1.8 to 36.3 m³/h	1 US gpm 0.23 m³/h

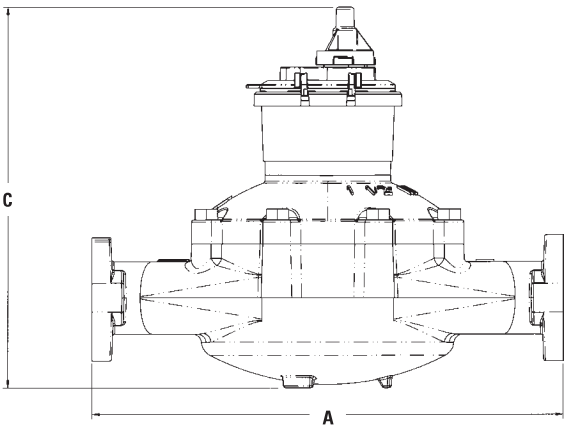
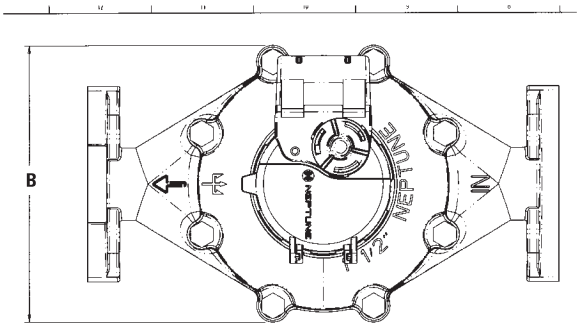
DIMENSIONS

Meter Size	A in/mm	B in/mm	C-Std. in/mm	C-ARB in/mm	C-E-Coder) R900i™	D-Threads per inch	D-Thread Type	E in/mm	Weight lbs/kg
1 1/2" Screw End	12 5/8 321	8 1/8 205	8 1/8 206	8 13/16 220.3	10 1/8 225.4	11 1/2	1 1/2 NPT	2 5/8 65	31 14.1
1 1/2" Flanged End	13 330	8 1/8 205	8 1/8 206	8 13/16 220.3	10 1/8 225.4	—	—	2 5/8 65	35 15.9
2" Screw End	15 1/4 387	9 1/8 240	9 5/8 237	9 15/16 248.4	11 3/8 289	11 1/2	2" NPT	3 1/8 79	40 18.1
2" Flanged End	17 432	9 1/8 240	9 5/8 237	9 15/16 248.4	11 3/8 289	—	—	3 1/8 79	44 20.0

T-10 WITH STANDARD REGISTER



T-10 WITH E-CODER/R900i PIT REGISTER



GUARANTEED SYSTEMS COMPATIBILITY

All T-10 meters are guaranteed adaptable to our ARB®V, ProRead™ (ARB VI), E-Coder® (ARB VII), E-Coder®R900i™, TRICON®/S, TRICON/E®3, and Neptune ARB Utility Systems without removing the meter from service.

REGISTRATION

ProRead Registration			
(per sweep hand revolution)		1 1/2"	2"
100	US Gallons	✓	✓
100	Imperial Gallons	✓	✓
10	Cubic Feet	✓	✓
1	Cubic Metre		✓
0.1	Cubic Metre	✓	
Register Capacity			
ProRead & E-Coder		1 1/2"	2"
100,000,000	US Gallons	✓	✓
100,000,000	Imperial Gallons	✓	✓
10,000,000	Cubic Feet	✓	✓
100,000	Cubic Metres	✓	✓
E-Coder High Resolution			
(8-digit reading)		1 1/2"	2"
1	US Gallons	✓	✓
1	Imperial Gallons	✓	✓
.01	Cubic Feet	✓	✓
0.001	Cubic Metres	✓	✓

SPECIFICATIONS

- Certification: NSF/ANSI 61, Annex G and Annex F
- Application: cold water measurement of flow in one direction
- Maximum operating water pressure: 150 psi (1034 kPa)
- Maximum operating water temperature: 80°F
- Measuring chamber: nutating disc technology design made from proprietary synthetic polymer

OPTIONS

- Sizes:
 - 1 1/2" flanged or threaded end
 - 2" flanged or threaded end
- Units of measure: U.S. gallons, imperial gallons, cubic feet, cubic metres
- Register types:
 - Direct reading: Bronze box and cover (standard)
 - Remote reading: ProRead Absolute Encoder, E-Coder, E-Coder®R900i, TRICON/S, TRICON/E3
 - Reclaim
- Measuring chamber: synthetic polymer
- Companion flanges: cast iron or lead free high copper alloy
- Environmental Conditions:
 - Operating temperature: 33°F to 149°F (0°C to 65°C)
 - Storage temperature: 33°F to 158°F (0°C to 70°C)
- Test Ports: 1"

Neptune engages in ongoing research and development to improve and enhance its products. Therefore, Neptune reserves the right to change product or system specifications without notice.

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Fax: (525) 55203 6503



NEPTUNE
TECHNOLOGY GROUP

neptunetg.com

Series 37G

- ▶ Fits inside pipe I.D.
- ▶ Fastened with internal expansion clamp.
- ▶ Features all-elastomer, maintenance-free design.
- ▶ Is custom-built to customer specifications.
- ▶ Closes on entrapped solids.

Materials of Construction

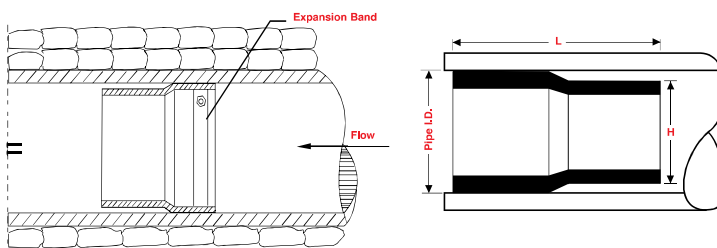
- ▶ Valves are available in pure gum rubber, neoprene, Hypalon®, buna-N, Viton® and EPDM.
- ▶ Stainless steel expansion clamps.



The Series 37G InLine Check Valve was developed specifically for installations where clearance below the invert of a pipe is insufficient to clear the flange of the standard Series 37. The 37G effectively has a zero face-to-face dimension since it can be completely slipped into an existing pipe. Piping modifications are not required to provide space for the valve. The Series 37G design uses the slip-on principle in reverse.

A special clamp that expands outward is provided to secure the valve to the inside of a pipe, enabling the valve to be installed easily on the outlet pipe from a manhole, such as in a CSO system.

The pressure drop of the Series 37G is increased because of the smaller I.D. required to fit the check valve in the line. Tideflex® Technologies recommends the valves be pinned to the pipe. Each clamp has four pre-drilled holes to allow installation of anchors/bolts. Contact our engineering staff for additional information.



Dimensions Series 37G Check Valve

Nominal Size* (Pipe I.D.)	Length L	Height of Bill H	Max. Backpressure (psi)	
			Standard Tideflex®	With Saddle Support
2	5	1 7/8	150	CONTACT FACTORY
3	5 1/2	2 7/8	100	
4	7	3 7/8	75	
6	11	5 7/8	75	
8	12 1/2	7 7/8	60	
10	15 1/2	9 7/8	45	
12	18 1/2	11 7/8	35	
14	22	13 3/4	25	
16	23	15 3/4	20	
18	24	17 3/4	15	
20	32	19 3/4	10	
24	37	23 3/4	10	
30	41	29 3/4	8	
36	47	35 3/4	8	
42	49	41 1/2	5	
48	52	47 1/2	5	
54	57	53 1/2	5	
60	64	59 1/2	5	
72	73	71 1/2	5	

Numbers indicate maximum dimensions in inches.

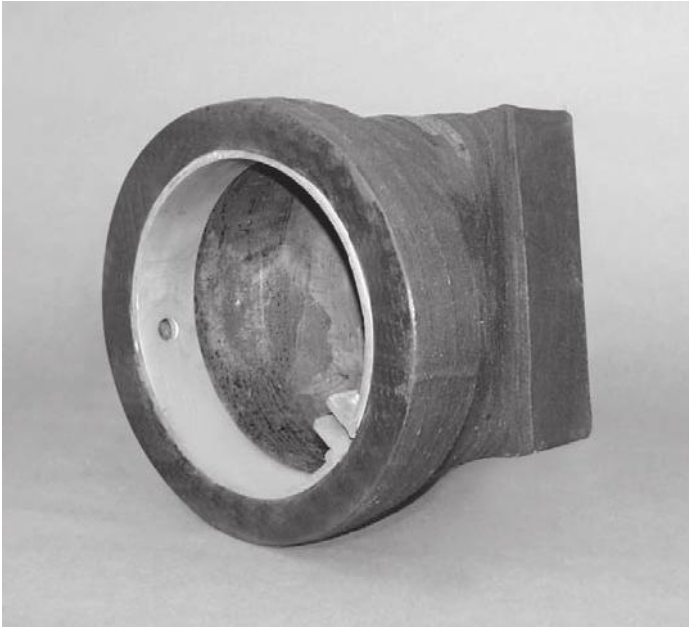
Contact engineering staff to verify overall dimensions.

* Other sizes available; consult factory. Valves are also made for non-standard pipe I.D.'s.

SERIES 37G

IN-LINE CHECK VALVES

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL



The revolutionary design of the Series 37-G In-Line Check Valve provides superior backflow protection. This unique "duckbill" design eliminates costly backflow from oceans, rivers, and other waterbodies and piping systems.

The Series 37G is available in a wide variety of elastomers and is designed to meet your exact flow specifications.

The "Cuff" of the Series 37G valves are constructed to have the same outside diameter as the inside diameter of the mating pipe. This allows the valve to be inserted into the pipe and held in place by means of an internal expansion clamp. **Tideflex® Technologies recommends pinning all Series 37G valves for added security and stability.**

37G's effectively have a zero face-to-face dimension because they fit completely inside of the pipe. No modification of piping is required provided adequate pipe length exists.

- Simple Design
- Cost Effective
- No Hinges, Levers or Springs
- Minimal Routine Maintenance

IMPORTANT

Please take a moment to **review this manual. Before performing any maintenance on the pressure sensors be sure the pipeline has been depressurized.** The improper installation or use of this product may result in personal injury, product failure, or reduced product life. Tideflex® Technologies can accept NO liability resulting from the improper use or installation of this product. If you have any questions or problems, please call the customer service department at (412) 279-0044. We appreciate your comments. Thank you for choosing Tideflex® Technologies.

INSTALLATION

1. Inspection of Valve

Check inside diameter of pipe section for rough or damaged areas. Surface should be uniform and relatively smooth. Long gouges or cracks may allow water to pass and should be filled prior to installation. The exterior of the Series 37G should have a rough texture resembling a cloth pattern. This will help the valve grip the walls of the pipe.

2. Valve Orientation

The bill of the Series 37G must be installed vertically. Valves to 18" (nominal) are supplied with a single clamp. The clamp turnbuckle should be oriented at top dead center.

Valves 24"—48" (nominal) are supplied with two clamps. The turnbuckles should be oriented 180° apart. Valves 60"—72" (nominal) are supplied with three clamps. Turnbuckles should be oriented 120° apart.

3. Pipe Dimensions

Every Series 37G is designed and built to fit into a specific pipe inside diameter. Different pipe materials such as concrete, HDPE, steel, and PVC have different I.D. dimensions for the same nominal pipe size. Do not attempt to install a Series 37G into a pipeline for which it was not intended.

4. Preparation

The Series 37G uses expanding clamp(s) to exert pressure outwards on the walls of the valve to "wedge" it in place within the pipe. The walls of the pipe should be clean and free of debris prior to installation.

5. Securing

The valve should be inserted fully into the pipe so that no part of the cuff or bill extends outside the pipe. Ensure that the valve is not "slanted" at an angle, with the bill pointing upwards or downwards. The valve centerline should be parallel to the pipe centerline.

Tideflex® Technologies recommends pinning the Series 37G on all installations. See below.

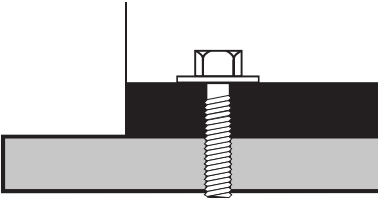
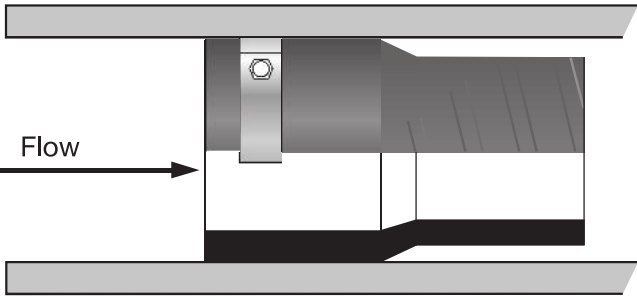
Four pre-drilled holes are provided in each expansion clamp. At least one clamp should be pinned. On exposed pipe, holes can be drilled through the valve and pipe, and a bolt run through secured with a nut. For buried pipe, silicon or similar sealant should be used to seal bolts.

NEVER...
Install the valve at an angle

NEVER...
Use Sharp Tools on Rubber

NEVER...
Exceed Design Back Pressure

NEVER...
Install the Valve Backwards



INSTALLATION NOTES FOR SERIES 37G

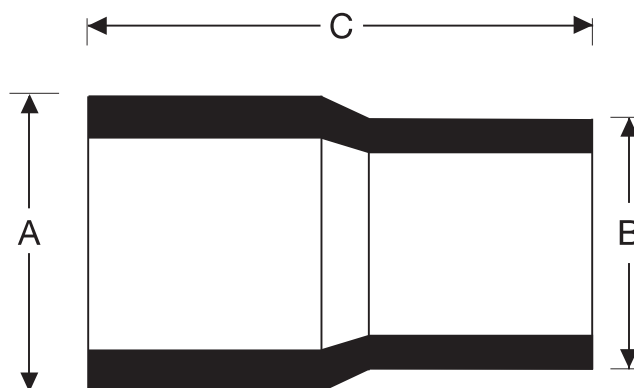
A. It is important that the Series 37G are installed level within the pipe. An equal amount of space must exist above and below the end of the bill. The Series 37G may "gap open" if installed improperly.

B. The bill of the Series 37G must have room to expand outwards, while bottom of the bill area rises. The area around the bill must be kept free of debris to allow the bill to close in order for the valve to seal properly.

C. The Series 37G effectively reduces the inside diameter of the pipe in which it is installed, creating a restriction. It may also create a "ledge" inside the pipe, causing standing water.

D. Back pressure in excess of the maximum line pressure may invert the sleeve and cause valve failure.

E. Should the conditions that the Series 37G was designed for change, (line pressure, back pressure, chemical compatibility) the performance of the valve may suffer.



Nominal Pipe I.D./Valve Size* (A)	Maximum Bill Height (B)	Maximum Length (C)	Maximum Back Pressure (psi)
6"	5-7/8"	11"	75
8"	7-3/4"	12-1/4"	75
10"	9-3/4"	15-1/4"	65
12"	11-3/4"	18-1/4"	65
14"	13-1/2"	21-1/4"	50
16"	15-1/2"	22-3/4"	50
18"	17-1/2"	23-3/4"	25
20"	19-1/2"	31-3/4"	25
24"	22"	37"	25
30"	27"	40-1/2"	15
36"	34"	46-3/4"	15
42"	40"	49"	10
48"	45"	51-1/2"	10
60"	57"	63-7/8"	10
72"	69"	72-1/2"	10

*For pipe I.D.'s other than the nominal pipe I.D.'s shown, consult factory to verify 37G dimensions.

MAINTENANCE

1. Inspection

Valves should occasionally be inspected for damage, wear, and buildup of debris. The frequency of the inspections should be determined by the severity of the service and the environment in which it operates.

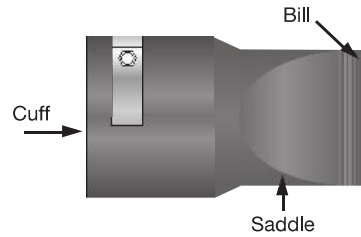
The clamp should be checked for proper tension, and be sure that the inside of the valve is free of debris. Soft marine growth is normal on valves in submerged applications, and because hard marine growth such as barnacles will not bond well to the Tideflex® they can be easily removed. Also insert pins to ensure they are tight.

STORAGE

If your Series 37G is to be stored for a period of time prior to installation, the following storage guidelines will help to preserve the valve and assure a trouble-free installation.

1. Store in a clean, cool, dry location. Avoid exposure to light, electric motors, dirt, or chemicals.
2. Store valve vertically on floor or pallet.
3. Store valve to prevent other items from contacting check sleeve to prevent possible damage.

4. Store this manual with the valve, so that is readily available at time of installation.



TROUBLESHOOTING GUIDE

SLEEVE INVERTED

- Excessive back pressure, water surge, or water hammer.

LEAKING AROUND PERIMETER OF VALVE

- Tighten Clamp
- Check for cracks and holes in surface of pipe

BACKFLOW

- Debris lodged inside bill
- Debris built up beneath bill

TIDEFLEX® TECHNOLOGIES WARRANTY

WARRANTIES - REMEDIES - DISCLAIMERS - LIMITATION OF LIABILITY

Unless otherwise agreed to in writing signed by Tideflex® Technologies, all Products supplied by Tideflex® Technologies will be described in the specifications set forth on the face hereof.

THE WARRANTIES SET FORTH IN THIS PROVISION ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED (INCLUDING ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OR TRADE).

Tideflex® Technologies Products are guaranteed for a period of one year from date of shipment, against defective workmanship and material only, when properly installed, operated and serviced in accordance with Tideflex® Technologies' recommendations. Replacement for items of Tideflex® Technologies manufacture will be made free of charge if proved to be defective within such year; but not claim for transportation, labor or consequential damages shall be allowed. We shall have the option of requiring the return of the defective product to our factory, with transportation charges prepaid, to establish the claim and our liability shall be limited to the repair or replacement of the defective product, F.O.B. our factory. Tideflex® Technologies will not assume costs incurred to remove or install defective products nor shall we incur back charges or liquidated damages as a result of warranty work. Tideflex® Technologies does not guarantee resistance to corrosion erosion, abrasion or other sources of failure, nor does Tideflex® Technologies guarantee a minimum length of service, or that the product shall be fit for any particular service. Failure of purchaser to give prompt written notice of any alleged defect under this guarantee forthwith upon its discovery, or use, and possession thereof after an attempt has been made and completed to remedy defects therein, or failure to return product or part for replacement as herein provided, or failure to install and operate said products and parts according to instructions furnished by Tideflex® Technologies, or failure to pay entire contract price when due, shall be a waiver by purchaser of all rights under these representations. All orders accepted shall be deemed accepted subject to this warranty which shall be exclusive of any other or previous warranty, and shall be the only effective guarantee or warranty binding on Tideflex® Technologies, anything on the contrary contained in purchaser's order, or represented by any agent or employee of Tideflex® Technologies in writing or otherwise, notwithstanding implied warranties. TIDEFLEX® TECHNOLOGIES MAKES NO WARRANTY THAT THE PRODUCTS, AUXILIARIES AND PARTS ARE MERCHANTABLE OR FIT FOR ANY PARTICULAR PURPOSE.



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Carnegie, PA 15106

phone: 412 279-0044

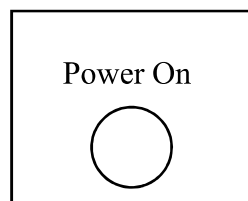
fax: 412 279-7878

WEB: www.tideflex.com

APPENDIX E

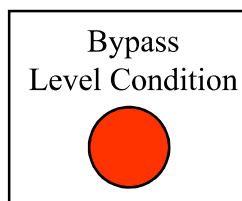
STORMWATER TREATMENT SYSTEM SPECIFICATIONS

Main O/W Separator Control Panel



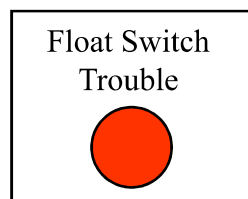
Power On

Light should always be on and indicates pumps and control panel have power



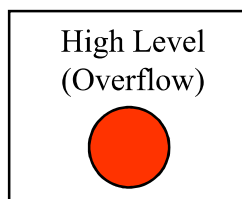
Bypass
Level Condition

Emergency Alarm. The pit is full at this point and water may be overflowing into the last compartment. Insure pumps are running. Document bypass for required notification to Agency.



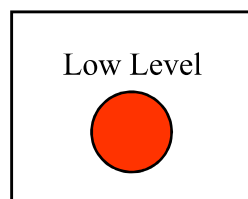
Float Switch
Trouble

Informational Alarm. Indicates pump automation may not be functioning properly. Acknowledge horn and operate pumps manually as necessary. Arrange maintenance.



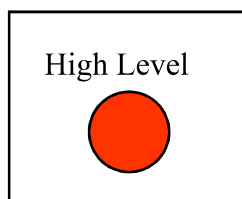
High Level
(Overflow)

Informational Alarm and turns on second pump. This indicates a very high flow rate at the V-notch. Acknowledge horn and make sure both pumps are on.



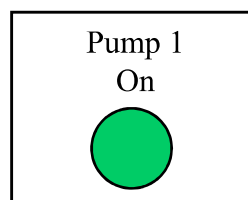
Low Level

Informational Alarm. Indicates pit has been pumped to low and may indicate a problem with "off" float switch. Acknowledge horn and make sure pumps are off.



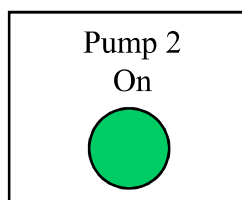
High Level

Informational Alarm and turns on second pump. Acknowledge horn and make sure both pumps are on.



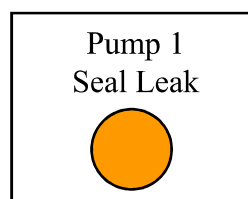
Pump 1
On

Light is on when pump is running. South Pump.



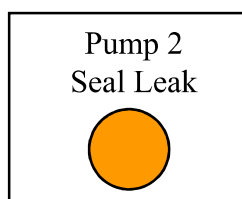
Pump 2
On

Light is on when pump is running. North Pump.



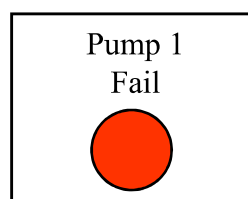
Pump 1
Seal Leak

Light normally off. If light is on it indicates a maintenance issue with the pump. Turn this pump to the Off position and arrange for maintenance.



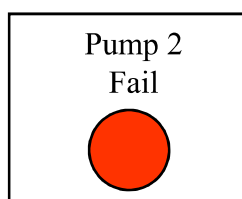
Pump 2
Seal Leak

Light normally off. If light is on it indicates a maintenance issue with the pump. Turn this pump to the Off position and arrange for maintenance.



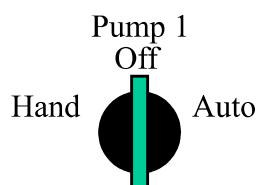
Pump 1
Fail

Indicates the pump should be on but no flow is being detected. Investigate, turn pump off, and turn other pump to on position and operate manually as necessary.

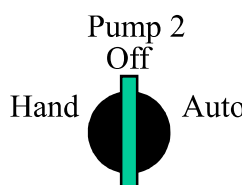


Pump 2
Fail

Indicates the pump should be on but no flow is being detected. Investigate, turn pump off, and turn other pump to on position and operate manually as necessary.



Pump 1
Off

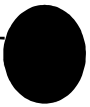


Pump 2
Off

Main Oil/Water Separator

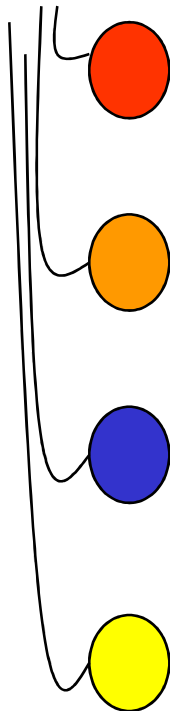
Float Switches

One float switch between the steel baffle and the final compartment



Bypass level alarm. This alarm is to inform us that we may be experiencing a bypass of the treatment vaults, document for notification to the WA Dept of Ecology.

Four float switches near the pumps



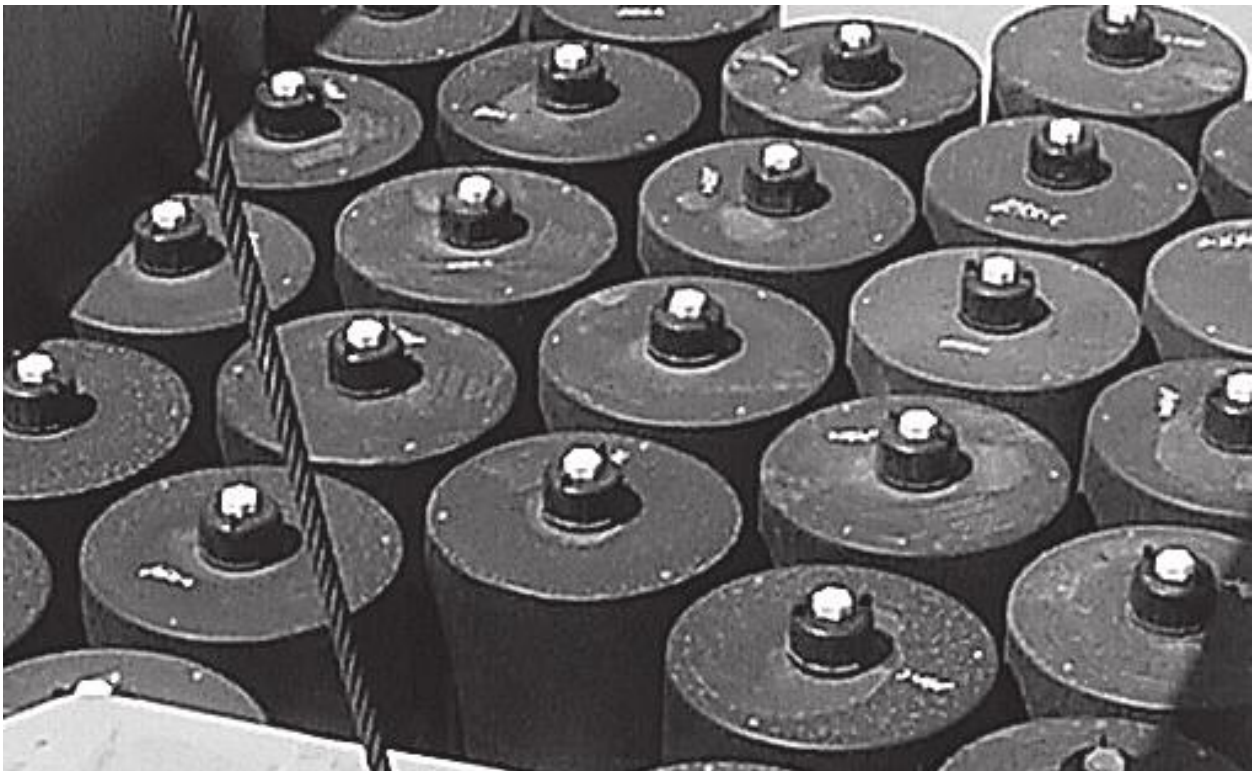
High level. This float will turn the second pump on and also activate the high alarm on the control panel.

Pump on. When water rises, this float turns one pump on.

Pump off. When water is pumped low enough, this float will turn the pump(s) off.

Low Level. Normally submerged. If water is pumped to low this switch will act as a secondary shutdown for the pumps and cause the Low Level alarm light on the panel to activate

Configuration Guide



The Stormwater Management StormFilter®

The Stormwater Management StormFilter® (StormFilter) is a passive, flow-through, stormwater filtration system. The system is comprised of one or more structures that house rechargeable, media-filled cartridges which trap particulates and adsorb materials such as dissolved metals, hydrocarbons, and nutrients in polluted runoff.

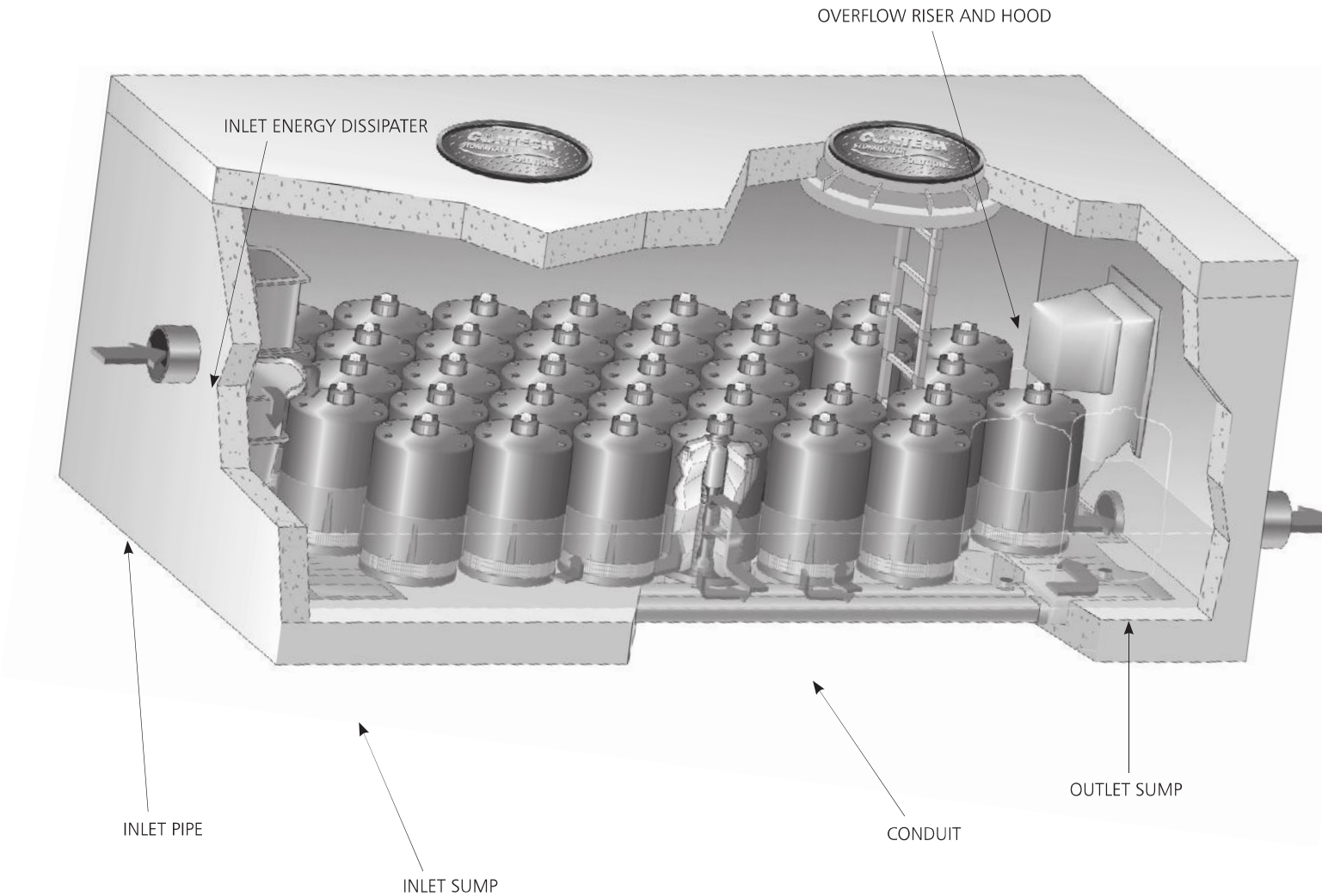
The StormFilter system comes in a variety of configurations and sizes to meet any site need. A variety of filter media is available and can be customized for each site to remove the desired pollutants.

Basic Design

The StormFilter is sized to treat the peak flow of a water quality design storm. The peak flow or WQv is determined from calculations based on the contributing watershed hydrology and from a design storm magnitude set by the local stormwater management agency. The StormFilter system is modular and each unit is designed with the number of cartridges required to meet the peak design flow rate, WQv or cap.

The flow rate through each filter cartridge is set to meet the jurisdictional performance requirements, allowing control over the amount of contact time between the influent and the filter media. The maximum flow rate through each cartridge can be adjusted, between 0.26 gpm/ft² and 2 gpm/ft² of surface area, using a calibrated restrictor disc at the base of each filter cartridge. Adjustments to the cartridge flow rate will affect the number of cartridges required to treat the peak flow or WQv.

Please contact your local CONTECH representative for site-specific design assistance.



Basic Operation

Priming System Function

The system is designed to siphon stormwater runoff through the StormFilter cartridge. Stormwater enters a StormFilter cartridge, percolates horizontally through the cartridge's filter media and collects in the center tube where the float valve is in a closed (downward) position.

As water passes through the filter media and into the cartridge's center tube, the air in the cartridge is displaced by the water and purged from beneath the filter hood through the one-way check valve located in the cap. Once the center tube is filled with water, there is enough buoyant force to open the float valve and allow the treated water in the center tube to flow into the under-drain manifold. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, the entire filter cartridge is used to filter water throughout the duration of the storm, regardless of the water surface elevation in the unit. This siphon continues until the water surface elevation drops to the elevation of the hood's scrubbing regulators, and the float returns to a closed position. Utilizing the hydraulic potential in the cartridge, the scrubbing regulators cause the filter surface to be clean of attached sediments thus extending the filter's operational life.

Flow and Valve Control

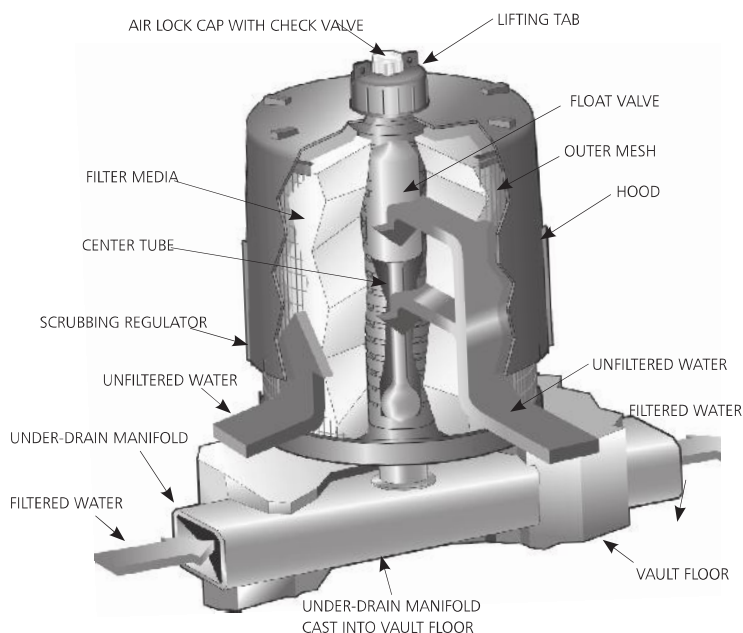
The filtration rate through a typical StormFilter cartridge can be adjusted so that it has a maximum flow rate of 2 gpm/ft² at

the design driving head. The flow rate is individually controlled for each cartridge by a restrictor disc located at the connection point between the cartridge and the under-drain manifold. Consisting of a simple orifice disc of a specific diameter, the flow rate through the cartridges can be adjusted to a level that coincides with your treatment requirements by using a disc with the appropriate orifice diameter.

A reduction in flow rate affects the performance of the StormFilter system with regards to both sediment and soluble pollutants. For solids, Stokes' Law predicts the movement of sediment in a fluid and it has been proven that a reduction in the flow velocity through the system will facilitate increased settling and capture of sediments. In addition, some media types have the ability to remove soluble pollutants through chemical processes, like ion exchange. A reduction in the flow velocity through the StormFilter cartridge will increase the contact time between the stormwater and the media, thereby increasing the removal efficiency by increasing the time for a chemical process to take place.

Media type can be changed, but flow rate adjustment requires engineering consultation to ensure hydraulic demands are satisfied.

Through routine maintenance, a media filtration system can adjust the media type to target or update the system to treating specific pollutants, new TMDLs, or changing pollutants of concern. The media change out can provide a long-term solution to changing regulatory requirements.



StormFilter Configurations

The StormFilter technology can be configured to meet your unique site requirements.

Downstream Treatment Configurations

Conventional stormwater treatment involves collecting, conveying and treating stormwater runoff with an end of pipe treatment system before discharging off-site. StormFilter configurations suitable for these applications are listed below and can be engineered to treat a wide range of flows.

Vault/Manhole

The Vault/Manhole consists of one or more precast concrete structures ranging from 48" manholes to 8' x 24' vaults. The largest unit treats water quality design flows up to 3.75 cfs, and can be placed in series or in parallel to treat higher flows if needed.

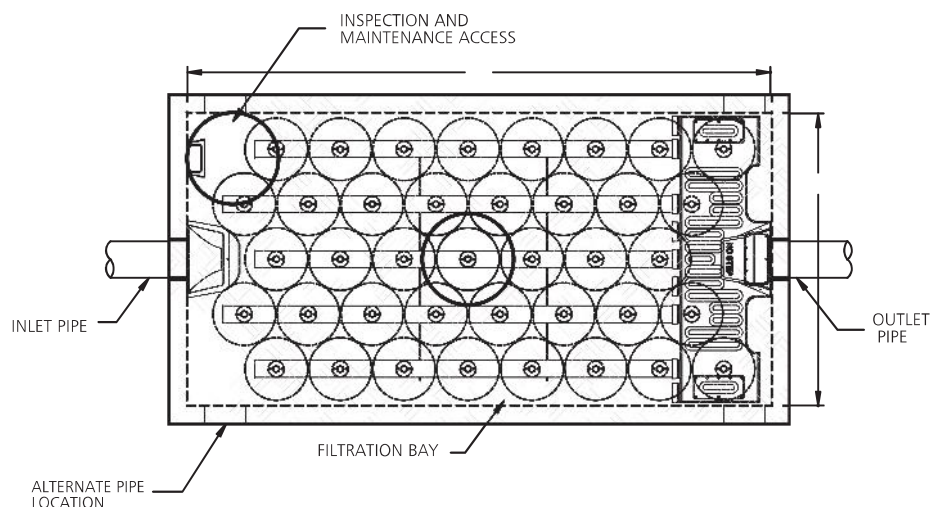
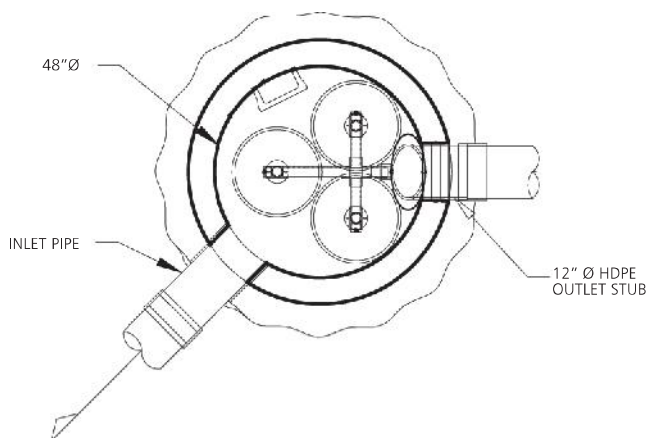
A Vault/Manhole configuration can be installed online or offline from storm system, where the unit has internal overflow bypass. These systems can also be installed offline, where high flows are bypassed around the treatment system and there is no internal overflow. However, if detention, pretreatment, or bypassing is required, it can be installed offline of the storm system.

Basic Operation

Vault/Manhole systems are housed in either a vault or manhole. Stormwater first enters the structure through the inlet pipe where it is directed through the energy dissipator. This gently spreads the flow to minimize re-suspension of previously captured pollutants.

Once in the filtration area, the stormwater begins to pond and percolate horizontally through the media contained in the filter cartridges. After passing through the media, treated water that has collected in the cartridge center tube is directed into the outlet sump by an under-drain manifold. The treated water in the outlet sump is then discharged through the outlet pipe.

Precast StormFilter systems have an internal bypass capability from 1.0 cfs to 2.0 cfs, depending upon the size of the system. If peak flows to the system exceed 2.0 cfs, an offline high flow bypass is needed.



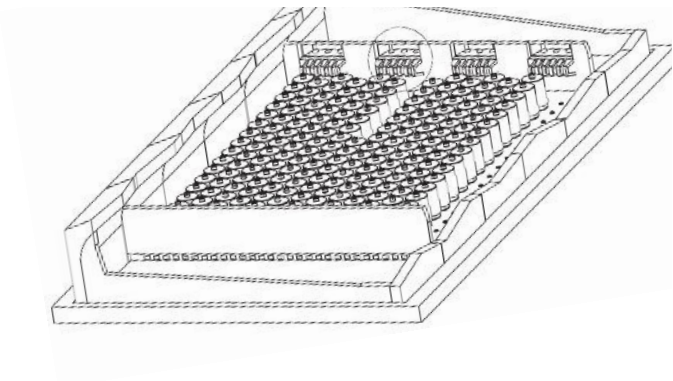
Vault/Manhole StormFilter

High Flow StormFilter

High Flow StormFilter systems can be designed within a variety of structures to meet local requirements and streamline installation. These systems are designed for large sites and large flows. Too big for standard precast structures, they are usually built from precast components that are assembled on site. The High Flow StormFilter is available in several configurations: CON/SPAN®, Panel Vaults, Box Culverts, or Cast-In-Place.

Basic Operation

The High Flow StormFilter design has the same basic configuration and components as the Precast StormFilter but operates on a larger scale.



High Flow StormFilter

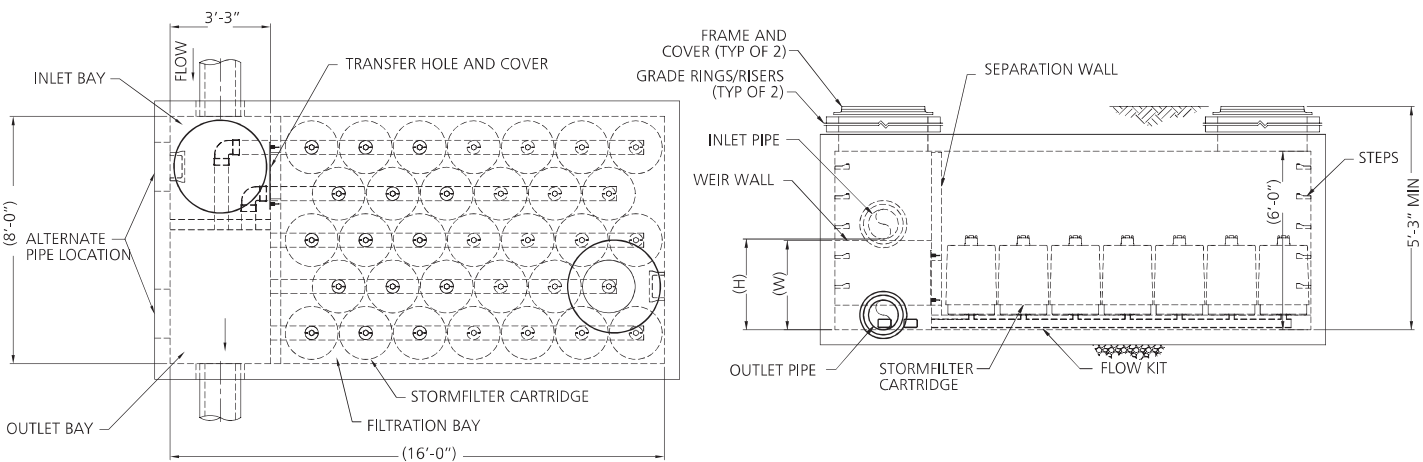
Peak Diversion StormFilter

The Peak Diversion StormFilter includes a treatment chamber and offline by-pass capability in one precast vault. Sizes range from 8'x11" to 8'x24" in most areas. Larger units can treat up to 2.5 cfs depending on cartridge height and the approved flow rate of regulatory jurisdiction. The integrated off-line bypass eliminates upstream flow splitters, downstream junction structures, and additional piping to save space and reduce the overall foot print. This lowers materials and installation cost while reducing potential conflicts with right of way (ROW) boundaries and utilities.

Basic Operation

Stormwater enters the structure through one or two inlet pipes into the inlet bay and low flows are directed to the filtration bay through a transfer opening. Once in the filtration area, the stormwater begins to pond and percolate horizontally through the media contained in the filter cartridges. After passing through the media, treated water that has collected in the cartridge center tube is directed into the outlet bay by an under-drain manifold. The treated water in the outlet sump is then discharged through the outlet pipe.

During large storm events greater than the treatment capacity, peak flows are diverted across the overflow weir directly to the outlet. Even during high flows the cartridges are still operating and water is entering the filtration bay from the inlet bay. This continuous flow into the filter bay helps ensure pollutants can not be washed out during high flow events.



Peak Diversion StormFilter

Volume StormFilter

The Volume StormFilter is designed to meet volume-based regulations where a specific water quality volume (WQv) must be captured and treated. In addition to the treatment, the structure can be sized to capture all or a portion of the WQv.

Restrictor discs inside each cartridge can be used to control the discharge rate from the system. The size of the disc is calibrated to provide the design filtration rate at a live storage depth. Because of these discs (and the airlock cap with a one way vent) water can be impounded above the cartridges in the treatment bay.

Structures range in size from a 48" manhole to CON/SPAN sections with a 24' x 10' cross section built to length. In many cases smaller structures are combined with outboard storage, such as pipe, to provide the WQv storage.

The Volume StormFilter can be designed with or without an internal bypass. If peak flows to the system exceed the internal bypass, or external bypass. If peak flows to the system exceed the internal bypass, or external bypass is required, a high flow bypass is needed. The system can also be installed online or offline and uses a traffic-bearing lid.

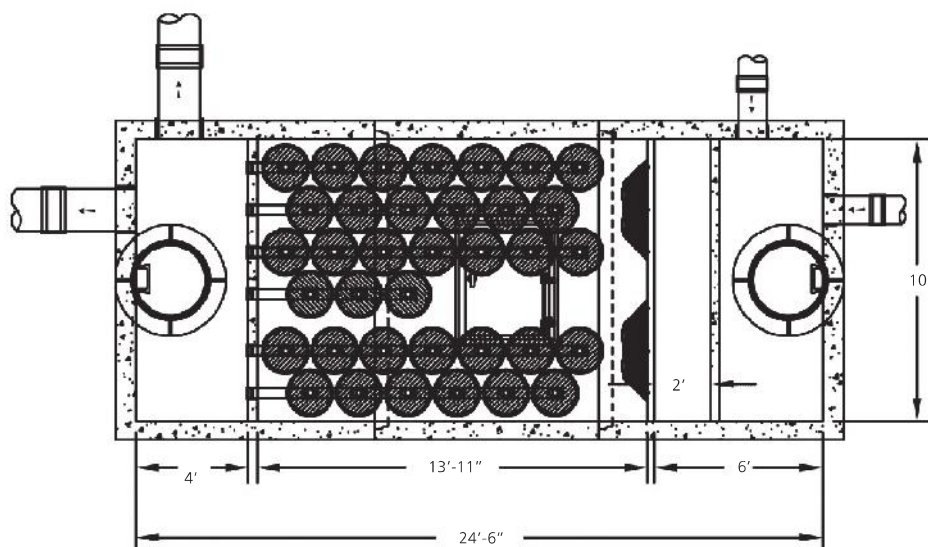
Basic Operation

The Volume StormFilter is typically configured in one of two ways.

A three bay system that incorporates internal storage for the WQv and includes: the storage bay, the filtration bay, and the outlet bay. Water first enters the storage bay (a portion of which includes dead storage) which facilitates pretreatment (gravity separation) and storage of the WQv. The stormwater is then directed into the filtration bay for full treatment and additional storage. The storage bay can be designed with a baffle to trap floatables, oils, and surface scum. Cartridges in the filtration bay treat the stormwater and control the discharge rate. Once in the filtration bay, the stormwater percolates horizontally through the media contained in the filter cartridges. After passing through the cartridge, treated water is directed to the outlet bay by an under-drain manifold where it is discharged through an outlet pipe.

A two bay, precast vault bases system similar to the Vault StormFilter where pretreatment and live storage are provided upstream.

Providing WQv storage in an outboard storage facility such as storage pipe provides the versatility to meet most footprint and elevation requirements.



Volume StormFilter

Upstream Treatment Configurations

Low Impact Design (LID) involves managing runoff close to the source using small, decentralized system. The following suite of StormFilter configurations are easily incorporated on sites where LID site design is recommended. These low-cost, lowdrop, point-of-entry systems also work well when you have a compact drainage area.

CatchBasin StormFilter

The CatchBasin StormFilter (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit that contains up to four StormFilter cartridges. The steel CBSF is offered both as a standard and as a deep unit.

The CBSF is installed flush with the finished grade and is applicable for small drainage areas from roadways and parking lots, and retrofit applications. It can also be fitted with an inlet pipe for roof leaders or similar applications.

The CBSF unit treats water quality design flows up to 0.20 cfs, coupled with an internal weir overflow capacity of 1.0 cfs for the standard steel and concrete units and 1.8 cfs for the deep steel units. Non-traffic rated plastic CBSF units have an internal weir overflow capacity of 0.5 cfs.

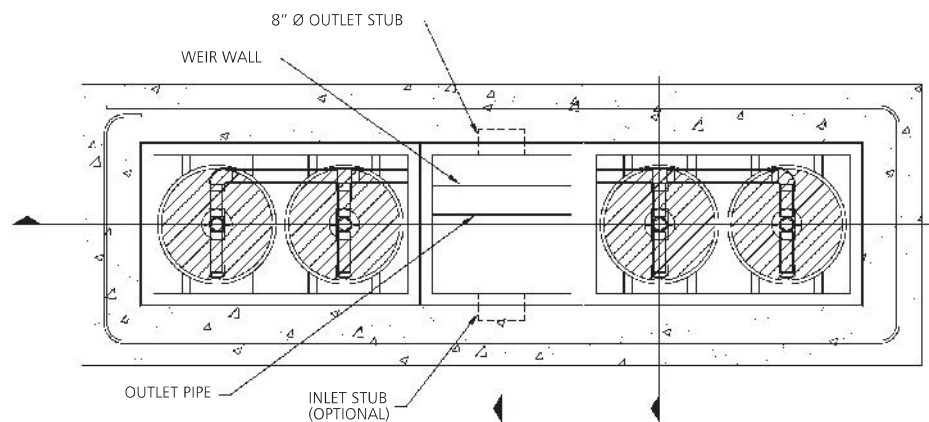
Basic Operation

The CBSF acts as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units each have an H-20 rated, traffic-bearing lid that allows the filter to be installed in parking lots and take up no land area. Plastic CBSF units can be used in landscaped areas and for other non-traffic bearing applications.

The CBSF consists of a sumped inlet chamber and cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit. The inlet chamber's internal baffle traps debris and floating oil, and houses an overflow weir. Heavier solids settle into the deep sump, while lighter solids and soluble pollutants are directed under the baffle and into the cartridge chamber through a port between the baffle and the overflow weir. Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed by an under-drain manifold to the outlet pipe on the downstream side of the overflow weir and discharged.

When flows into the CBSF exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

The CBSF is particularly useful where small flows are being treated or for sites that are flat and have little available hydraulic head to spare. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.



CatchBasin StormFilter

Curb Inlet StormFilter

The Curb Inlet StormFilter consists of a precast concrete vault ranging from 6'x8' to 8'x16' in size. These units can treat water quality design flows up to 1.2 cfs. The system is installed online and includes an internal offline overflow bypass around the filtration chamber. The internal bypass capability is based on depth of the structure. The standard bypass capacity is 15 cfs but is larger for deeper units. A traffic-bearing lid is placed underneath the median or sidewalk adjacent to the roadway.

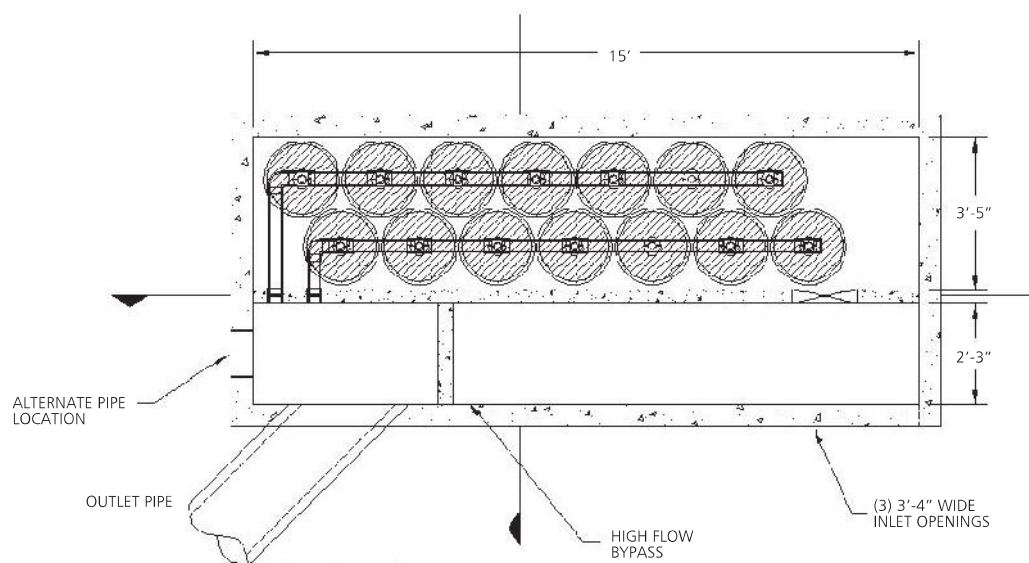
Basic Operation

The Curb Inlet StormFilter is composed of three bays: the inlet bay, the filtration bay, and the outlet bay. Stormwater enters the inlet bay through the curb inlet opening. The design flow is directed through a transfer opening to the filtration bay for full treatment.

Once in the filtration bay, the stormwater percolates horizontally through the media in the filter cartridges to the center tube. Treated water in the cartridge center tube is directed into the outlet bay by an under-drain manifold and discharged through the outlet pipe. Outlet pipes can be placed parallel, perpendicular, or up to 45° to the roadway. Overflow is directed over a weir wall between the inlet bay and the outlet bay, bypassing the filtration bay leaving accumulated pollutants undisturbed.

Curb Inlet Openings

Every Curb Inlet StormFilter is designed to meet local regulations governing the geometry of the curb inlet. This can be accomplished in two ways. One way is with an integrated face plate – the vault lid includes the face plate which is tied into the curb. Another way is with a cast-in-place face plate – the entire face plate is constructed by the contractor pouring the curb. Curb inlet openings can be 4', 7', or 10' in length.



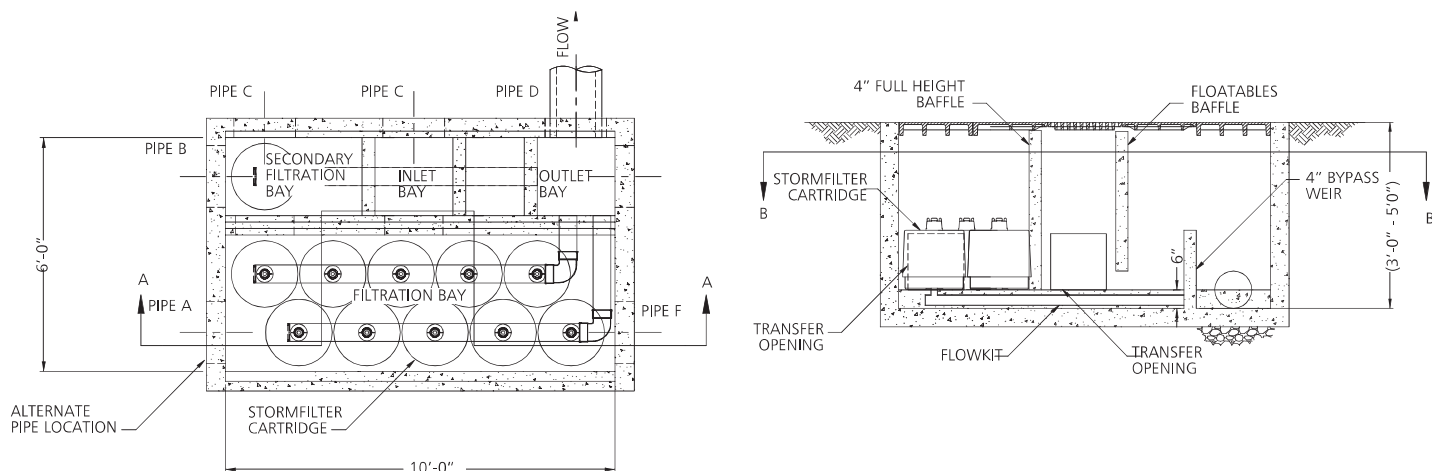
Curb Inlet StormFilter

Linear Grate StormFilter

The Linear Grate StormFilter is a precast vault that acts as the primary receiver of runoff, similar to a standard grated catch basin. The unit has H-20 rated traffic bearing lids that allow the filter to be installed under parking lots. The system consists of an inlet bay, filtration bay, and an outlet bay. Providing treatment as it enters the conveyance system reduces the overall head loss because the vertical drop from the finished grade into the conveyance system is also used to provide hydraulic pressure on the filter cartridges.

Basic Operation

Runoff enters the inlet bay by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit. The inlet bay's internal baffle traps debris and floating oil and denser pollutants are directed into the filtration bay. Once in the cartridge chamber, polluted water ponds and percolates through a radial media filter cartridge. Treated water collects in the cartridge's center tube where it is directed by an underdrain manifold to the outlet pipe on the downstream side of the overflow weir. When flow rates exceed the water quality design value, excess water spills across the overflow weir, bypassing the cartridge bay and proceed directly to the outlet pipe. The integrated offline bypass ensures pollutants captured in the filtration bay are not washed downstream during peak flow events.



Linear Grate StormFilter

Grated Inlet Openings

The number of inlet grates and the size of the inlet bay are designed to capture the peak flow rates from the drainage area. The remaining area is devoted to the filtration bay and the outlet bay which are covered with removable plates for access during maintenance. The entire inlet bay, filtration bay, and outlet bay can be opened at one time allowing full access. In many cases, due to the shallow nature of the design, confined space entry is not required for maintenance.

Linear StormFilter

The Linear StormFilter consists of one or two precast concrete channels that are 10' or 20' in length and 2' 9" in width.

The Linear StormFilter is installed flush with the finished grade, functioning similar to a catch basin or trench drain. The top of the unit has either covers or doors for easy access. The Linear StormFilter is typically installed online like the precast StormFilter.

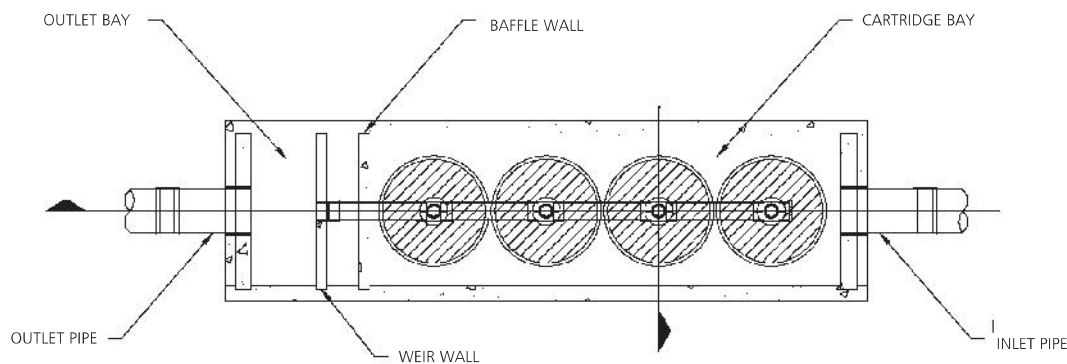
The Linear StormFilter unit treats water quality design flows up to 0.27 cfs.

Basic Operation

The Linear StormFilter can be installed either as the primary receiver of runoff, similar to a grated catch basin, or with an inlet stub and doors to receive runoff collected upstream.

The system is equipped with an internal overflow weir to ensure that there is no local flooding for storm events in excess of the design treatment flow. Maintenance costs for the unit are typically less because there are no confined space entry requirements, and access is quick and easy.

The Linear StormFilter is particularly useful where small flows are being treated or where the site is very flat and there is little available hydraulic head to spare.



Linear StormFilter

Infiltration Configuration

Dry Well StormFilter

The Dry Well StormFilter provides treatment, infiltration and groundwater protection in a single structure. The system is designed to treat conveyed flow or sheet flow from small drainages. Multiple units can be installed to treat any size site. Because it provides treatment and infiltration in a single unit, the total number of structures and the amount of pipe required for the stormwater system are reduced.

The Dry Well StormFilter system is available in 48", 60" and 72-" pre-cast manhole top sections that are designed to be stacked on top of dry well infiltration risers. The StormFilter portion of the unit arrives fully assembled and ready to install, including an integrated concrete deck for the StormFilter cartridges. The system can also be retrofitted into existing 48" manhole dry wells.

Basic Operation

Stormwater enters the dry well unit through one or more entry pipes or channels at its top. It then percolates through the media in the StormFilter cartridge to the center tube. Treated water in the cartridge center tube is discharged to the infiltration section below, and then infiltrates into the surrounding soils through a number of small exit openings at the sides and bottom.

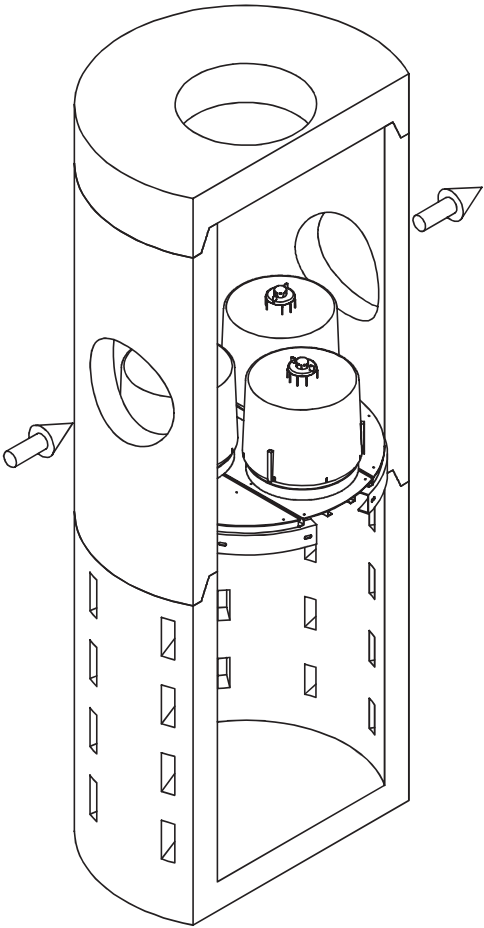
Roof Runoff Treatment Configuration

Downspout StormFilter

The Downspout StormFilter is an aboveground configuration that can be easily integrated into existing gutter systems to eliminate pollution from rooftop runoff. It typically occupies 2.5' x 5' footprint, and can fit most downspout configurations and sizes. Each unit holds two StormFilter cartridges, and single- and dual-stage options are available. It treats up to 14,000 square feet of rooftop area per dual-cartridge system.

StormFilter Cartridges

There are three cartridge heights available for StormFilter systems: 27", 18", and Low Drop. The most economical is the 27" tall cartridge. It can treat the highest flow rate per cartridge, which creates the smallest system with the lowest installed cost. The 27" cartridge requires 3.05' of driving head to operate. For sites with less driving head available, the 18" cartridge is the next best option. Lower flow rates per cartridge increase the footprint of the overall system but only 2.3' of driving head is required. For sites with very limited drop, the Low Drop cartridge only requires 1.8" of driving head.



DryWell StormFilter

Cartridge Flow Rates

Cartridge Type	Hydraulic Drop	Treatment Capacity (gpm)	
		1 gpm/ft2	2 gpm/ft2
StormFilter 27"	3.05'	11.25	22.5
StormFilter 18"	2.30'	7.5	15
StormFilter Low Drop	1.80'	5	10

StormFilter Media

The removal of site-specific pollutants can be maximized with the variety of filtration media available. In many cases, different media types can be combined so as to target a wide spectrum of pollutants. This ability to combine and use various media types allows the system to be easily adjusted to meet ever-changing site conditions and increasingly stringent regulatory requirements.

PhosphoSorb™

PhosphoSorb, a lightweight media comprised of Perlite (a heat-expanded volcanic rock) and activated alumina, removes total phosphorus (TP) by absorbing dissolved-P and filtering particulate-P simultaneously. The Perlite provides the capability to remove suspended solids while the activated alumina absorbs soluble phosphorus absorption.



PhosphoSorb is composed of a slightly finer gradation than the field proven ZPG™ (Zeolite, Perlite, Granular Activated Carbon) media and will provide equivalent - or even better - removal of suspended solids. Initial field tests have indicated an increase in the TSS removal efficiency up to 10% over the field-proven ZPG media. The StormFilter with ZPG media has already received a General Use Level Designation for basic treatment in the State of Washington.

Perlite

Perlite is a natural, volcanic ash, similar in composition to glass and similar in appearance to pumice. To use perlite as a filter medium, it must first go through a heating process to yield a lightweight, multicellular, expanded form. This expanded form has a coarse texture, very low-density, high surface area, and stable, inert chemistry, all of which make perlite an excellent physical filtration medium.



Perlite has proven to be our media of choice for sediment and oil removal. The multicellular nature of expanded perlite is the key to its excellent ability to trap sediments and adsorb oil. The coarse texture of the expanded perlite creates a bed of material with a very high porosity, which allows perlite to have the highest sediment and oil storage capacity of all of the available media options.

Zeolite

The term zeolite defines a family of both natural and synthetic, hydrous aluminosilicate materials with a highly porous mineral matrix that holds light, alkali metal cations (ideally sodium ions).



Zeolite has the ability to use a cation exchange reaction that removes other cations such as zinc, copper, lead, and ammonia from water. In the cation exchange reaction, the light metal cations in the zeolite matrix are displaced by the heavier metal cations, such as copper, in the water.

The zeolite used in our system is clinoptilolite, which has a cation exchange capacity (CEC) of approximately 100 to 220 meq/100 g. Clinoptilolite has inert characteristics that make it an excellent metals removal media option when CSF media cannot be used. It can be combined with other media such as GAC and perlite when metals are not of exclusive concern.

CSF® Leaf Media

CSF Leaf Media is a patented filtration media composed of composted deciduous leaves originating from the City of Portland, Oregon. CONTECH Stormwater Solutions purchases the mature, stable, deciduous leaf compost and then processes it into an odorless, pelletized compost product with physical and chemical characteristics desirable for stormwater filtration.



The patented compost process creates a material with excellent flow-through characteristics and stability in water. Not only do CSF Leaf Media consist of 100% recycled, all natural materials, but it also provides good removal of sediments and excellent removal of a wide range of toxic contaminants.

CSF Leaf Media provides the multitude of beneficial water treatment properties typical of soil in a form that is compatible with the compact, modular, media-based design of the StormFilter system. In addition to the physical filtration provided by the granular nature of the CSF Leaf Media, the complex chemistry of the compost also provides chemical filtration as well.

Sediment and total nutrients are removed through physical filtration. Oil, complexed metals, and anthropogenic organic contaminants such as herbicides and pesticides are removed through adsorption, the physical partitioning of organic compounds, such as pesticides, to carbon-rich materials, such as the compost.

Soluble metals are removed by cation exchange, as well as by complexation of metal ions to the organic chelating agents present in compost. CSF Leaf Media is an excellent, cost-effective, all-purpose media that epitomizes the potential value of recycled materials.

GAC

GAC (Granular Activated Carbon) is a widely accepted water filtration media used for the removal of organic compounds. It consists of pure carbon (originating from coal or charcoal) whose micro-porous structure has been enhanced through steam or acid "activation."



The high carbon content and porous nature of GAC accounts for its excellent ability to remove organic compounds through adsorption. Since adsorption is the physical partitioning of organic compounds to high carbon surfaces, the "activation" of the carbon (which creates GAC) endows it with an enormous surface area upon which adsorption can take place.

In situations where anthropogenic organic contaminants are of exclusive concern, GAC media provide the highest level of stormwater treatment compared to other available media options. However, because it is not very often the case that anthropogenic organic contaminants are of exclusive concern, GAC is usually combined with another media such as perlite or zeolite for the treatment of additional contaminants.

Combination of GAC with perlite constitutes the most cost-effective configuration, as the effectiveness of GAC is drastically reduced if it is coated with high concentrations of heavy oil or sediment, which can restrict access via surface pores to the interior of the GAC granules.

ZPG™ (Zeolite, Perlite, GAC blend)

This proprietary blend of zeolite, perlite, and granular activated carbon media is used to provide an alternative for CSF media for installations where leaf media cannot be used.



Laboratory and Field Testing

The StormFilter system is designed to meet the most stringent regulatory requirements. The field-proven performance of the StormFilter has led to hundreds of regulatory agency approvals nationwide as a standalone BMP.

The Stormwater Management StormFilter® is the first manufactured BMP to receive stand-alone approval through field testing and satisfying the total suspended solids treatment requirements in Washington and New Jersey.

Log on to www.contechstormwater.com/stormfilter to view the following reports in full.

Field Monitoring Reports

Field Proven Performance of the StormFilter using the Technology Assessment Protocol - Ecology (TAPE) and Technology Acceptance Reciprocity Partnership (TARP) Tier II Protocol

1. Washington
 - a. Washington State Department of Ecology General Use Level Designation for Basic Treatment
 - b. Technical Evaluator Engineering Report (TEER). Gary Minton, Ph.D., P.E.
2. New Jersey
 - a. New Jersey State Department of Environmental Protection Final Certification
 - b. New Jersey Corporation for Advanced Technology (NJCAT) Field Verification Report

Laboratory Reports

Total Suspended Solids (TSS) Removal Using Different Particle Size Distributions with the Stormwater Management StormFilter.

Influences on TSS removal efficiency

Influence of analytical method, data summarization method, and particle size on total suspended solids (TSS) removal efficiency of the StormFilter

StormFilter removal efficiency with coarse/fine perlite media

Evaluation of the removal of silt loam TSS using coarse/fine perlite at 28 L/min (7.5 gpm).

StormFilter removal efficiency with ZPG media

Evaluation of the removal of SIL-CO-SIL 106 using ZPG media at 28 L/min (7.5 gpm)

StormFilter removal efficiency with coarse perlite

Evaluation of the removal of sandy loam TSS using coarse perlite at 57 L/min (15 gpm)

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from CONTECH Stormwater Design Engineers.

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CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

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StormFilter Inspection and Maintenance Procedures



Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.



In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

Inspection

One time per year

After major storms

Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.



3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.

7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)



1. Sediment loading on the vault floor.
 - a. If $>4"$ of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
 - a. If $>1/4"$ of accumulation, maintenance is required.
3. Submerged cartridges.
 - a. If $>4"$ of static water in the cartridge bay for more than 24 hours after end of rain event, maintenance is required.
4. Plugged media.
 - a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
 - a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
 - a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
 - a. If pronounced scum line (say $\geq 1/4"$ thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
 - a. If system has not been maintained for 3 years maintenance is required.

Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online
- Outlet pipe is clear of obstruction
- Construction bypass is plugged

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from CONTECH Construction Products.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH Construction Products for suggested attachment devices.



Important: Note that cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

- B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless CONTECH Construction Products performs the maintenance activities and damage is not related to discharges to the system.

- C. Set the used cartridge aside or load onto the hauling truck.
- D. Continue steps a through c until all cartridges have been removed.

Method 2:

- A. Enter the vault using appropriate confined space protocols.
- B. Unscrew the cartridge cap.
- C. Remove the cartridge hood screws (3) hood and float.
- D. At location under structure access, tip the cartridge on its side.

Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

- D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.
- E. Set the empty, used cartridge aside or load onto the hauling truck.
- F. Continue steps a through e until all cartridges have been removed.



- 8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
- 9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
 - a. Replace any damaged connectors.
- 10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
- 11. Close and fasten the door.
- 12. Remove safety equipment.
- 13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH Construction Products.



Related Maintenance Activities -

Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.



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Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

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Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

[illegible]

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: Personnel:

Location: System Size:

System Type: Vault Cast-In-Place Linear Catch Basin Manhole Other

List Safety Procedures and Equipment Used:

System Observations

Months in Service: Oil in Forebay: Yes No Sediment Depth in Forebay: Sediment Depth on Vault Floor: Structural Damage:

Drainage Area Report

Excessive Oil Loading: Yes No Source: Sediment Accumulation on Pavement: Yes No Source: Erosion of Landscaped Areas: Yes No Source:

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes No Details: Replace Cartridges: Yes No Details: Sediment Removed: Yes No Details: Quantity of Sediment Removed (estimate?): Minor Structural Repairs: Yes No Details: Residuals (debris, sediment) Disposal Methods:

Notes:

StormFilter Maintenance Guidelines

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site, and may be required in the event of a chemical spill or due to excessive sediment loading.

Maintenance Procedures

Although there are other effective maintenance options, CONTECH recommends the following two step procedure:

1. Inspection: Determine the need for maintenance.
2. Maintenance: Cartridge replacement and sediment removal.

Inspection and Maintenance Activity Timing

At least one scheduled inspection activity should take place per year with maintenance following as warranted.

First, inspection should be done before the winter season. During which, the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, maintenance should be performed during periods of dry weather.

In addition, you should check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation. It may be necessary to adjust the inspection/maintenance activity schedule depending on the actual operating conditions encountered by the system.

Generally, inspection activities can be conducted at any time, and maintenance should occur when flows into the system are unlikely.

Maintenance Activity Frequency

Maintenance is performed on an as needed basis, based on inspection. Average maintenance lifecycle is 1-3 years. The primary factor controlling timing of maintenance of the StormFilter is sediment loading. Until appropriate timeline is determined, use the following:

Inspection:

- One time per year
- After major storms

Maintenance:

- As needed
- Per regulatory requirement
- In the event of a chemical spill

Inspection Procedures

It is desirable to inspect during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH immediately.

To conduct an inspection:

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. Use the following as a general guide. (Other factors, such as regulatory requirements, may need to be considered)

1. Sediment loading on the vault floor. If $>4"$ of accumulated sediment, then go to maintenance.
2. Sediment loading on top of the cartridge. If $>1/4"$ of accumulation, then go to maintenance.
3. Submerged cartridges. If $>4"$ of static water in the cartridge bay for more than 24 hrs after end of rain event, then go to maintenance.
4. Plugged media. If pore space between media granules is absent, then go to maintenance.
5. Bypass condition. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), then go to maintenance.
6. Hazardous material release. If hazardous material release (automotive fluids or other) is reported, then go to maintenance.
7. Pronounced scum line. If pronounced scum line (say $\geq 1/4"$ thick) is present above top cap, then go to maintenance.
8. Calendar Lifecycle. If system has not been maintained for 3 years, then go to maintenance.

Assumptions:

No rainfall for 24 hours or more.

No upstream detention (at least not draining into StormFilter).

Structure is online. Outlet pipe is clear of obstruction. Construction bypass is plugged.

Maintenance

Depending on the configuration of the particular system, workers will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flow is occurring.

Replacement cartridges can be delivered to the site or customers facility. Contact CONTECH for more information.

Warning: In the case of a spill, the worker should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH immediately.

To conduct cartridge replacement and sediment removal:

1. If applicable, set up safety equipment to protect workers and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

- A. This activity will require that workers enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH for suggested attachment devices.

Important: Cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Do not damage the manifold connectors. They should remain installed in the manifold and can be capped during the maintenance activity to prevent sediments from entering the under drain manifold.

- B. Remove the used cartridges (up to 250 lbs.) from the vault.

Important: Avoid damaging the cartridges during removal and installation.

- C. Set the used cartridge aside or load onto the hauling truck.
- D. Continue steps A through C until all cartridges have been removed.

Method 2:

- A. Enter the vault using appropriate confined space protocols.
- B. Unscrew the cartridge cap.
- C. Remove the cartridge hood screws (3) hood and float.
- D. At location under structure access, tip the cartridge on its side.

Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

- E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.
 - F. Set the empty, used cartridge aside or load onto the hauling truck.
 - G. Continue steps a through E until all cartridges have been removed.
8. Remove accumulated sediment from the floor of the vault and from the forebay. Use vacuum truck for highest effectiveness.
 9. Once the sediments are removed, assess the condition of the vault and the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
 - a. Replace any damaged connectors.
 10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Take care not to damage connections.
 11. Close and fasten the door.
 12. Remove safety equipment.
 13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH.

Material Disposal

The accumulated sediment must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals. Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with applicable waste disposal regulations. Coordinate disposal of solids and liquids as part of your maintenance procedure. Contact the local public works department to inquire how they disposes of their street waste residuals.